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ESSAY XVIII.

OF THE EXCELLENT QUALITIES OF
COFFEE,
AND THE ART OF MAKING IT IN THE
HIGHEST PERFECTION.

ILLUSTRATED BY COPPER-PLATES.

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ESSAY XVIII.

THE use of science is to explain the operations which take place in the practice of the arts, and to discover the means of improving them; and there is no process, however simple it may appear to be, that does not afford an ample field for curious and interesting investigation.

As those domestic arts, and elegant refinements, which the progress of industry, and the increase of wealth and knowledge introduce in society, contribute to the comfort and happiness of great numbers of respectable individuals; their improvement must be interesting to all those who take pleasure in contemplating the prosperity of mankind, and in contributing to their innocent enjoyments.

Among the numerous luxuries of the table, unknown to our forefathers, which have been imported into Europe in modern times, *Coffee* may be considered as one of the most valuable.

Its taste is very agreeable, and its flavour uncommonly so ; but its principal excellence depends on its salubrity, and on its exhilarating quality.

It excites cheerfulness, without intoxication ; and the pleasing flow of spirits which it occasions, lasts many hours, and is never followed by sadness, languor, or debility.

It diffuses over the whole frame, a glow of health, and a sense of ease and well-being, which is exceedingly delightful. Existence is felt to be a positive enjoyment, and the mental powers are awakened, and rendered uncommonly active.

It has been facetiously observed, that there is more wit in Europe since the use of Coffee has become general among us ; and I do not hesitate to confess, that I am seriously of that opinion.

Some of the ablest, most brilliant, and most indefatigable men I have been acquainted with, have been remarkable for their fondness for Coffee ; and I am so persuaded of its powerful effects in clearing up the mind, and invigorating its faculties, that on very interesting occasions, I have several times taken an additional dose of it for that very purpose.

That Coffee has greatly contributed to our innocent enjoyments, cannot be doubted ; and experience has abundantly proved, that so far from being unwholesome, it is really very salubrious.

This delicious beverage has so often been celebrated, both in prose and verse, that it does not stand in need of my praises to recommend it ; I shall

I shall therefore confine myself to the humble office of shewing how it can be prepared in the greatest perfection *.

There is no culinary process that is liable to so much uncertainty in its results, as the making of Coffee; and there is certainly none in which any small variation in the mode of operation, produces more sensible effects.

With the same materials, and even when used in the same proportions, this liquor is one day good, and the next bad; and nobody perhaps can even guess at the cause of this difference; and what renders these variations of greater importance, is this remarkable circumstance, that when Coffee is bad, when it has lost its peculiar aromatic flavour, which renders it so very agreeable to the organs of

* If I have abstained from giving a botanical description of the evergreen shrub which produces Coffee; with an account of its culture, and the various attempts that have been made by chemists to analyze its grain, it is because this information (which would necessarily take up a good deal of room, without being particularly interesting to most readers) may be found in other books.

The same reasons have prevented my giving a history of the introduction of the use of Coffee in Europe, and of the introduction of the plant which produces it, into the American Islands, and from thence into the tropical regions of the Continent of America.

It is well known that this precious plant was first found growing wild in Arabia; and that it does not prosper, except in very hot climates, and in hilly countries.

taste and of smell; it has lost its exhilarating qualities, and with them, all that was valuable in it.

Different methods have been employed in making Coffee; but the preparation of the grain is nearly the same in all of them. It is first roasted in an iron pan, or in a hollow cylinder, made of sheet-iron, over a brisk fire; and when, from the colour of the grain, and the peculiar fragrance which it acquires in this process, it is judged to be sufficiently roasted, it is taken from the fire, and suffered to cool. When cold it is pounded in a mortar; or ground in a hand-mill to a coarse powder, and preserved for use.

Great care must be taken in roasting Coffee, not to roast it too much; as soon as it has acquired a deep cinnamon colour, it should be taken from the fire, and cooled; otherwise much of its aromatic flavour will be dissipated, and its taste will become disagreeably bitter.

In some parts of Italy, Coffee is roasted in a thin Florence flask, slightly closed by means of a loose cork. This is held over a clear fire of burning coals, and continually agitated. As no visible vapour ever makes its appearance within the flask, the colour of the Coffee may be distinctly seen through the glass, and the proper moment seized for removing the Coffee from the fire.

I have endeavoured to improve this Italian method, by using a thin globular glass vessel, with
a long

a long narrow cylindrical neck. This globular vessel is six inches in diameter, and its cylindrical neck is one inch in diameter and eighteen inches long. It is laid down horizontally, and supported in such manner on a wooden stand, as to be easily turned round its axis. The globular vessel projects beyond the stand, and is placed, at a proper height, immediately over a chaffing dish of live coals. When this globular vessel is blown sufficiently thin; and when care is taken to keep it constantly turning round, when it is over the fire, there is not the smallest danger of its being injured by the heat, however near it may be to the burning coals.

In order that Coffee may be perfectly good, and very high flavoured, not more than half a pound of the grain should be roasted at once; for when the quantity is greater, it becomes impossible to regulate the heat in such a manner as to be quite certain of a good result.

The end of the cylindrical neck of the globular vessel should be closed by a fit cork, having a small slit in one side of it, to permit the escape of the vapour out of the vessel. This cork should project about an inch beyond the extremity of the neck of the vessel, in order that it may be used as a handle in turning the vessel round its axis, towards the end of the process, when the neck of the vessel becomes very hot. The progress of the operation, and the moment most proper to put an end to it, may be judged, and determined with great certainty; not

only by the changes which take place in the colour of the grain ; but also by the peculiar fragrance which will first begin to be diffused by it, when it is nearly roasted enough.

This fragrance is certainly owing to the escape of a volatile, aromatic, substance ; which did not originally exist, *as such*, in the grain ; but which is formed in the process of roasting it.

By keeping the neck of the globular vessel cold, by means of wet cloths, I found means to condense this aromatic substance, together with a large portion of aqueous vapour, with which it was mixed.

The liquor which resulted from this condensation, which had an acid taste, was very high flavoured, and as colourless as the purest water ; but it stained the skin of a deep yellow colour ; which could not be removed by washing with soap and water ; and this stain retained a strong smell of Coffee several days.

I have made several unsuccessful attempts to preserve the fragrant aromatic matter which escapes from Coffee when it is roasting, by transferring it to other substances. Perhaps others may be more fortunate.

But I must not suffer myself to be inticed away from my subject by these interesting speculations.

If the Coffee in powder is not well defended from the air, it soon loses its flavour, and becomes of little value ; and the liquor is never in so high perfection

fection, as when the Coffee is made immediately after the grain has been roasted.

This is a fact well known to those who are accustomed to drinking Coffee, in countries where the use of it is not controuled by the laws; and if a government is seriously disposed to encourage the general use of Coffee, individuals must be permitted to roast it in their own houses.

As the roasting and grinding of Coffee takes up some considerable time, and cannot always be done without inconvenience at the moment when the Coffee is wanted; I contrived a box for keeping the ground Coffee, which I have found, by several years' experience, to preserve the Coffee much better than any of the vessels commonly used for that purpose. It is a cylindrical box made of strong tin, four inches and a quarter in diameter, and five inches in height, formed as accurately as possible within, to which a piston is so adapted, as to close it very exactly; and when pressed down into it, to remain in the place where it is left, without being in danger of being pushed upwards by the elasticity of the ground Coffee, which it is destined to confine.

This piston is composed of a circular plate of very stout tin, which is soldered to the lower part of an elastic hoop of tin, about two inches wide, which is made to fit into the cylindrical box as exactly as possible; and so as not to be moved up and down in it, without employing a considerable force.

force. This hoop is rendered elastic, by means of a number of vertical flits made in the sides of it.

On the upper side of the circular plate of tin, which closes this hoop below, and in the centre of it, there is fixed a strong ring, of about one inch in diameter, which serves instead of a piston rod, or a handle for the piston. The cylindrical box is closed above by a cover, which is fitted to it with care, in order that the air, which is shut up within the box (between the piston and the cover) might be well confined.

Before I proceed to describe the apparatus I shall recommend for making Coffee, it will be useful to enquire what the causes are, which render the preparation of that liquor so precarious; and in order to facilitate that investigation, we must see what the circumstances are, on which the qualities depend, which are most esteemed in Coffee.

Boiling hot water extracts from Coffee, which has been properly roasted and ground, an aromatic substance, of an exquisite flavour, together with a considerable quantity of astringent matter, of a bitter, but very agreeable taste; but this aromatic substance, which is supposed to be an oil, is extremely volatile; and is so feebly united to the water, that it escapes from it into the air with great facility.

If a cup of the very best Coffee, prepared in the highest perfection, and boiling hot, be placed on a table, in the middle of a large room, and suffered

to cool, it will in cooling fill the room with its fragrance; but the Coffee, after having become cold, will be found to have lost a great deal of its flavour.

If it be again heated, its taste and flavour will be still farther impaired; and after it has been heated and cooled two or three times, it will be found to be quite vapid and disgusting.

The fragrance diffused through the air is a sure indication that the Coffee has lost some of its most volatile parts; and as that liquor is found to have lost its peculiar flavour, and also *its exhilarating quality*, there can be no doubt but that both these depend on the preservation of those volatile particles which escape into the air with such facility.

If the liquid were perfectly at rest, the volatile particles disseminated in it, could not escape; or at least not with the same facility as when it is agitated. Those at the surface of the liquid might fly off, but those below the surface would be confined and preserved.

Now all liquids, that are either heated or cooled, are necessarily disturbed and agitated; and the internal motions into which their particles are thrown, do not cease, till the heating or cooling process has ceased.

As the particles of fluids are much too small to be visible, the motions which take place among them cannot be seen; but means have nevertheless

less been found to render these motions quite evident.

If a small quantity of any solid substance, in the form of a coarse powder, and having the same specific gravity as any transparent liquid, be mixed with it, and the liquid be either heated or cooled, the currents formed in the liquid in consequence of the change of its temperature, will carry along with them the visible particles of the powder, diffused in the liquid, and the directions and velocities of those currents will become apparent.

The cause of these motions among the particles of liquids, that are heated or cooled, is perfectly known.

When a hot liquid is cooled, those of its particles which are the first exposed to the cooling influence, on losing a part of their heat, become specifically heavier than they were before; consequently they become specifically heavier than the surrounding hotter particles, which causes them to descend towards the bottom of the containing vessel.

This descent of the particles which are cooled necessarily puts the whole mass of the liquid in motion. The warmer and lighter particles are continually rising towards the surface of the liquid; while the colder and heavier particles are descending; and these motions never can cease, till the whole of the liquid has acquired the precise temperature of the surrounding atmosphere.

When

When the liquid is heated, similar motions take place; but in an opposite direction. The particles first heated, being rendered specifically lighter by this augmentation of temperature, rise upwards; and give place to the colder and heavier particles which descend.

These motions may be rendered visible by a very simple contrivance.

If one ounce of common salt be dissolved in eight ounces of water, a brine will be formed, which will have the same specific gravity as yellow amber; consequently, if a small quantity of that solid substance be pounded in a mortar, so as to be reduced to a coarse powder (of about the size of mustard seeds), this powder, on being put into the brine, will remain suspended in that liquid, and in all parts of it, without either sinking or rising to its surface; and the particles of the amber being visible in the brine, will, by their motions, indicate the motions and directions of the currents in the liquid, which take place when the temperature of the liquid is changed*.

If now, two like glass tumblers be filled, the one with the pure brine moderately heated, the other with an equal quantity of the same brine, at the same temperature, containing a small quantity of the powdered amber, intimately mixed with it, on

* In order that the brine may be rendered perfectly transparent, it should be filtered, or made to pass through filtering paper.

exposing these two glass vessels with their contents, to cool in the air, in a quiet room, no motion will be perceived among the particles of the pure brine (which are invisible), but the motions which will be seen to take place among the particles of amber in the other tumbler, will afford a convincing proof that the apparent rest in the pure brine must necessarily be a deception ; and that the particles of both these masses of cooling liquid are most undoubtedly in motion.

As soon as these liquids have acquired the temperature of the surrounding atmosphere, their internal motions will cease ; but on every change of temperature they will recommence.

We may conceive the particles of amber, disseminated in the brine, to represent the particles of the aromatic substance, disseminated in new-made Coffee : as long as the Coffee remains at rest, that is to say, as long as its temperature remains unchanged, these aromatic particles cannot escape ; for they cannot come to the surface of the liquid ; but when the liquid is put in motion, their escape is greatly facilitated.

When the cause of any evil is perfectly known, it is seldom very difficult to find means to prevent it.

In order that Coffee may retain all those aromatic particles which give to that beverage its excellent qualities, nothing more is necessary, than to prevent all internal motions among the particles of that liquid ;

liquid; by preventing its being exposed to any change of temperature, either during the time employed in preparing it; or afterwards, till it is served up.

This may be done, by pouring boiling water on the Coffee in powder; and surrounding the machine in which the Coffee is made, by boiling water; or by the steam of boiling water: for the temperature of boiling water is *invariable*, (while the pressure of the atmosphere remains the same,) and the temperature of steam is the same as that of the boiling water from which it escapes.

But the temperature of boiling water is preferable to all others for making Coffee, not only on account of its *constancy*, but also, on account of its being most favourable to the extraction of all that is valuable in the roasted grain.

As it is well known that the heat of boiling water is not that which is the most favourable for extracting from malt those saccharine parts which it furnishes in the process of making beer; I thought it possible, though not at all probable, that some lower temperature than that of boiling water, might also be most advantageous in preparing Coffee; but after having made a great number of experiments, in order to ascertain that important point, I found that Coffee, infused with boiling water, was always higher flavoured, and better tasted, than when the water used in that process was at a lower temperature.

I have

I have frequently taken Coffee, of the best quality, newly burnt, and with equal portions of it, in powder, and equal quantities of water, have made Coffee, in two like coffee-pots, with this single difference, that the water poured into one of them has been boiling hot; while that poured into the other, has been at some lower temperature; and I have constantly found, that the Coffee made with the boiling water has been preferred by all good judges; especially when they have been presented with the two kinds of Coffee at the same time, without being told in what manner they were prepared.

I have likewise made Coffee with cold water, and afterwards heated it; but this I have always found to be *of a very inferior quality*: it is very bitter, and not unfrequently of a sour disagreeable taste, especially when the cold water is a long time in passing through to Coffee in powder, and when they are suffered to remain together over night.

The fine aromatic substance is either not extracted by cold water, or it escapes afterwards, while the Coffee is heating. — The fact is, that very little of it can be perceived in the Coffee, after it has been heated; nor does Coffee, so prepared, possess those exhilarating qualities which render that beverage so delightful in its effects, when it is made in perfection, and taken before it has had time to be spoiled by cooling. As Coffee is an expensive article, which must be imported into Europe from hotter climates,

climates, the economy of it deserves attention; now it is quite certain that boiling water extracts from the prepared grain, more of those particles which give the agreeable taste and flavour to the Coffee, or, in other words, that give it *strength*; than an equal quantity of water less hot: this fact has been ascertained by many experiments, and is now generally acknowledged: it is indeed not a little surprising, that it should ever have been called in question; for the agency of heat, in facilitating solutions of this kind, has long been known.

As all kinds of agitation must be very detrimental to Coffee, not only when made, but also while it is making, it is evident that the method formerly practised, that of putting the ground Coffee into a coffee-pot, with water, and boiling them together, must be very defective, and must occasion a very great loss.

But that is not all; for the Coffee which is prepared in that manner can never be good, whatever may be the quantity of ground Coffee that is employed.

The liquor may, no doubt, be very bitter, and it commonly is so; and it may possibly contain something that may irritate the nerves, but the exquisite flavour and exhilarating qualities of good Coffee will be wanting.

A decoction of Jesuit's bark is also very bitter, and it is sometimes irritating, but nobody ever found it to be exhilarating; custom might perhaps

render the taste of it agreeable, for even the taste of tobacco becomes agreeable to those who are in the habit of chewing it; but it would be difficult to persuade me, or any other unprejudiced person, that Coffee is good, which has nothing to recommend it but a strong, bitter, austere taste.

Coffee may easily be too bitter, but it is impossible that it should ever be too fragrant. The very smell of it is reviving, and has often been found to be useful to sick persons, and especially to those who are afflicted with violent head-achs. In short, every thing proves that the volatile, aromatic matter, whatever it may be, that gives flavour to Coffee, is what is most valuable in it, and should be preserved with the greatest care; and that in estimating the strength, or richness of that beverage, its *fragrance* should be much more attended to, than either its bitterness or its astringency.

Nobody, I fancy, can be fonder of Coffee than I am; I have regularly taken it twice a day, for many years, and I certainly take care to have the very best that can be procured, and no expence is spared in making it good.

The reader will no doubt be surprised, when I assure him, that one pound averdupois, of good Moka Coffee, which, when properly roasted and ground, weighs only fourteen ounces, serves for making fifty-six full cups of the very best Coffee, in my opinion, that can be made.

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The quantity of ground Coffee which I use for one full cup, is 108 grains Troy, which is rather less than a quarter of an ounce. This Coffee, when made, would fill a coffee-cup, of the common size, quite full; but I use a larger cup, into which the Coffee being poured boiling hot, on a sufficient quantity of sugar (half an ounce), I pour into it about one-third of its volume of good sweet cream, *quite cold*. On stirring these liquids together, the Coffee is *suddenly cooled*, and in such a manner as not to be exposed to the loss of any considerable portion of its aromatic particles in that process.

In making Coffee, several circumstances must be carefully attended to: in the first place, the Coffee must be ground fine, otherwise the hot water will not have time to penetrate to the centers of the particles; it will merely soften them at their surfaces, and passing rapidly between them, will carry away but a small part of those aromatic and astringent substances on which the goodness of the liquor entirely depends.

In this case, the grounds of the Coffee are more valuable than the insipid wash which has been hurried through them, and afterwards served up under the name of Coffee.

This secret has been but too well known to some servants abroad, where Coffee is more generally used than in England, and where the preparation of it has not been controuled by the laws. When complaints are made that the Coffee is too weak,

they are never at a loss for a remedy for that evil ; and when it has once been established as a rule in the family, that *one ounce* of ground Coffee is *indispensably necessary* to make a cup of good strong Coffee, their point is gained.

But before we can determine with certainty how much ground Coffee is necessary in order to make a cup of good Coffee, we must ascertain the contents of a coffee-cup ; and as the sizes of coffee-cups are very different in different countries, and even vary considerably in the same country, we must begin by adopting some certain size, to serve as a standard. — The size most commonly to be met with in England, and in France, is a cup which contains $8\frac{1}{3}$ cubic inches, English measure, when filled quite full to the brim ; when this cup is made perfectly cylindrical within, and just as high as it is wide, it will be $2\frac{2}{5}$ English inches in diameter, and consequently $2\frac{2}{5}$ inches in height, internally.

One gill, or one quarter of a wine pint of liquor, will fill this cup to within *three-tenths* of an inch of the level of its brim, and that quantity of Coffee will weigh 1820 grains Troy, or something more than four ounces averdupois, or more exactly $4\frac{1}{5}$ ounces.

As a *gill* is a measure well known in England, I shall adopt it as a standard measure for a cup of Coffee ; and as it is inconvenient to fill coffee-cups quite full to the brim, I shall propose coffee-cups to be made of the form and dimensions they now

commonly have, or of a size proper for containing $8\frac{1}{3}$ cubic inches of liquor, when filled quite full to the brim.

As a gill is equal to 7.1875 cubic inches, about seven-eighths only of the capacity of the cup will, in that case, be occupied by the Coffee. — Now I have found, by the results of a great number of experiments, that *one quarter of an ounce* averdupois of ground Coffee is quite sufficient to make a gill of most excellent Coffee, of the highest possible flavour, and quite strong enough to be agreeable.

This decision has been the result of fifteen years' experience, and as Coffee is to me by far the most valuable luxury of the table, with which I am acquainted, and that in which I indulge with the greatest pleasure and satisfaction, I have spared no pains in my endeavours to find out how it can be prepared in the highest perfection: and I can safely assert that economy has not, in the smallest degree, influenced my opinion on that subject.

I am happy when I find that improvement leads to economy, but I have always thought that excellence should never be sacrificed to paltry savings in any thing, and least of all in those habitual enjoyments which are at the same time the comforts and consolations of life.

The fact is, with respect to Coffee, that when it is made very strong, its taste becomes so very bitter and austere, that it is no longer possible to distinguish that delicate aromatic fragrance which is

so liberally diffused when the Coffee is properly prepared.

Habit may render very bitter Coffee agreeable to some palates, and all persons may not perhaps be able to savour in perfection that peculiar fragrance which renders the smell of Coffee so very agreeable; but I am confident, that those who will take the trouble to make the experiment with due care, will find, as I have done, that Coffee, of the very best quality, may be prepared with the quantity of materials above-mentioned.

But this cannot be done, unless the method which I use be employed for making the Coffee.

In order that the advantages which will result from the adoption of that process may be perceived and estimated, it will be useful to give a short description of the method formerly pursued, and to explain the disadvantages which resulted from it.

Formerly, the ground Coffee being put into a coffee-pot, with a sufficient quantity of water, the coffee-pot was put over the fire, and after the water had been made to boil a certain time, the coffee-pot was removed from the fire, and the grounds having had time to settle, or having been fined down with ising-glass, the clear liquor was poured off, and immediately served up in cups.

From the results of several experiments, which I made with great care, in order to ascertain what proportion of the aromatic and volatile particles in the Coffee escape, and are left in this process, I
found

found reason to conclude, that it amounts to considerably more than half. This loss may easily be explained; it is occasioned principally, no doubt, by the motions into which the liquid is thrown in being heated, and afterwards on being made to boil; but there are two other unfavourable circumstances attending this process that deserve attention.

The air that is attached to the small solid particles of the ground Coffee, often remain attached to them, and causing them to rise up to the surface of the water, and to remain there, these particles contribute very little to the strength or qualities of the liquor; and even those particles which, becoming thoroughly soaked with the water, are mixed with it; as they are surrounded, not by pure water, but by a solution of Coffee, more or less saturated, that circumstance is unfavourable to their solution.

It is well known to chemists, that any solid substance, which is soluble in any liquid menstruum, is dissolved with greater difficulty, or more slowly, as the liquid is more charged with that substance.

Now, when Coffee is made in the most advantageous manner, the ground Coffee is pressed down in a cylindrical vessel, which has its bottom pierced with many small holes, so as to form a strainer, and a proper quantity of boiling hot water being poured cautiously on this layer of Coffee in powder, the water penetrates it by degrees, and after a certain time begins to filter through it.

This gradual percolation brings continually a succession of fresh particles of pure water into contact with the ground Coffee, and when the last portion of the water has passed through it, every thing capable of being dissolved by the water, will be found to be so completely washed out of it, that what remains will be of no kind of value.

It is however necessary to the complete success of this operation, that the Coffee should be ground to a powder sufficiently fine, as has already been observed.

This method of making Coffee, by percolation, has been practised many years, and its usefulness is now universally acknowledged. I do not know who was the first to propose it, but being thoroughly persuaded of the merit of the contrivance, I have been desirous of recommending it; and I conceived that the most effectual way of recommending it, would be to explain the mechanical and chemical principles on which its superiority depends.

In order that the Coffee may be perfectly good, the stratum of ground Coffee, on which the boiling water is poured, must be of a certain thickness, and it must be pressed together with a certain degree of force. If it be too thin, or not sufficiently pressed together, the water will pass through it too rapidly; and if the layer of ground Coffee be too thick, or if it be too much pressed together, the water will be too long in passing through it, and the taste of the Coffee will be injured.

Another

Another circumstance, to which little attention has hitherto been paid, but which I have found to be of considerable importance, is the levelling of the surface of the ground Coffee, after it has been put into the strainer, before any attempt is made to press it together.

When the ground Coffee is poured into the strainer it always stands much higher in one part of this vessel than elsewhere; and if, in that situation, it be pressed down on the perforated bottom of this vessel, without being previously levelled, it will be much more pressed in some parts than in others; and as the water will not fail to pass most rapidly, where it meets with the least resistance, a considerable portion of the ground Coffee will be so crowded together as to prevent the water from passing through it, and consequently will contribute little or nothing to the strength of the beverage.

To remedy this inconvenience, I use the following simple contrivance: The circular plate of tin, with a rod fastened to its centre, which serves as a rammer for pressing down the ground Coffee, has four small projecting square bars, of about one-tenth of an inch in width, fastened to the under side of it, and extending from the circumference of the plate to within about one quarter of an inch of its centre.

On turning this plate round its axis, by means of the rod which serves as a handle to it, (the rod being made to occupy the axis of the cylindrical vessel,)

vessel,) the projecting bars are made to level the ground Coffee; and after this has been done, and not before, the Coffee is pressed together.

This circular plate is pierced by a great number of small holes, which permit the water to pass through it, and it remains in the cylindrical vessel during the whole of the time that the Coffee is making. It reposes on the surface of the ground Coffee, and prevents its being thrown out of its place by the water which is poured on it.

The rod which serves as a handle to this circular plate is so short, that it does not prevent the cover of the cylindrical vessel from being put down into its place.

After having made a great number of experiments, in order to determine what thickness is best for the layer of ground Coffee, I have found that two-thirds of an inch answers best for the Coffee in powder, before it is pressed together, and that it ought to be so pressed as to be reduced to the thickness of something less than *half an inch*.

And as the quantity of ground Coffee necessary for making a cup of good Coffee (a quarter of an ounce averdupois) just fills a cylindrical measure, which is 1.15 inches in diameter and in height, its volume amounts to 1.1945 cubic inches; consequently, a cylindrical vessel (which I shall call the strainer) proper for making *one cup of Coffee*, must be of such diameter that 1.1945 cubic inches
of

of ground Coffee will fill it to the height of two-thirds of an inch.

On making the computation, it will be found that one inch and a half is the most proper diameter for the strainer to be employed in making one single cup of good Coffee. And as the thickness of the stratum of ground Coffee must always be the same, whatever may be the number of cups that are made at the same time; the diameter of strainers, of different sizes, will be as follows, viz.

	Inches.
For 1 cup - - - -	1.5
2 - - - -	2.1213
3 - - - -	2.5986
4 - - - -	3
5 - - - -	3.3541
6 - - - -	3.6742
7 - - - -	3.9687
8 - - - -	4.2426
9 - - - -	4.5
10 - - - -	4.7434
11 - - - -	4.9749
and for 12 - - - -	5.1962

For common use, the following sizes will answer very well; and, in order that workmen may not have the trouble of computing the heights of the cylindrical vessels, which I have called strainers, which contain the water that is poured on the
ground

ground Coffee, I have given these heights in the following Table. They have been determined on the supposition, that the diameter of the vessel is always just equal to the diameter of the perforated bottom by which it is closed below; and that the quantity of water necessary for making one cup of Coffee, is $8\frac{1}{3}$ cubic inches.

A Table, shewing the diameters and heights of the cylindrical vessels (or strainers) to be used in making the following quantities of Coffee :

Quantity of Coffee to be made at once.	Diameter of the strainer.	Height of the strainer.
1 cup - - -	$1\frac{1}{2}$ inches	$5\frac{1}{4}$ inches.
2 cups - - -	$2\frac{1}{8}$ - - -	$5\frac{1}{4}$
3 or 4 cups - -	$2\frac{3}{4}$ - - -	5
5 or 6 cups - -	$3\frac{1}{2}$ - - -	$5\frac{1}{8}$
7 or 8 cups - -	4 - - -	$5\frac{1}{4}$
9 or 10 cups - -	$4\frac{5}{8}$ - - -	$5\frac{1}{3}$
11 or 12 cups - -	5 - - -	$5\frac{1}{2}$

As there is so little difference in the heights of these strainers, and as a small additional height will be rather advantageous than otherwise, I would recommend them to be made all of the same height, viz. $5\frac{1}{2}$ inches in height.

As these strainers must be suspended in their reservoirs, which are destined for receiving the Coffee, and at such a height that after all the Coffee has
passed

passed through the strainer, the bottom of the strainer may still be above the surface of the Coffee in the reservoir; it will be best to make the reservoir of a conical form, and just large enough above to receive the strainer in such a manner that it may be suspended in the reservoir by means of a narrow projecting brim.

The boiler in which the reservoir is suspended may likewise be made conical, and of such diameter above, as to receive the reservoir in such a manner as to be firmly united to it.

The reservoir and its boiler must be foldered together above, at their brims; and the reservoir must be suspended in its boiler in such a manner, that its bottom may be about a quarter of an inch above the bottom of the boiler.

The small quantity of water which it will be necessary to put into the boiler, in order that the reservoir for the Coffee may be surrounded by steam, may be introduced by means of a small opening on one side of the boiler, situated above, and near the upper part of its handle.

The spout through which the Coffee is poured out passes through the side of the boiler, and is fixed to it by foldering. The cover of the boiler serves at the same time as a cover for the reservoir, and for the cylindrical strainer, and it is made double, in order more effectually to confine the heat.

The



copper; or of copper plated with silver, which will give to the boiler an elegant appearance, and at the same time render it easy to keep it clean on the outside.

The boiler may likewise be made of tin, and neatly japanned on the outside, provided the hoop to which it is fixed below be made of copper, but this hoop must never be japanned nor painted; and it must always be made of sheet-copper or silver; and the boiler must always be heated over a small portable fire-place or lamp, somewhat less in diameter above, than the hoop on which the boiler is placed.

In order that the flat bottom of the boiler may not smother and put out the fire, the brim of the small furnace or chaffing-dish, which is used, must have six projecting knobs, at the upper part of it, each about one quarter of an inch in height, on which the bottom of the boiler may rest.

If these knobs (which may be the large heads of six nails), be placed at equal distances from each other, the boiler will be well supported; and as the hot vapour from the fire will pass off freely between them, the fire will burn well. As a very small fire is all that can be wanted, no inconvenience whatever will arise from the heating of the boiler on the table, in a dining-room or breakfast-room, especially if a spirit lamp be used, and the quantity of heat wanted is so very small, when the
water

water is put boiling hot into the boiler, that the expence for spirits of wine, would not, in London, amount to one penny a day, when Coffee is made twice a day for four persons.

It is a curious fact, but it is nevertheless most certain, that *in some cases*, spirits of wine is cheaper, when employed as fuel, even than wood. With a spirit lamp, constructed on Argand's principle, but with a chimney made of thin sheet iron, which I caused to be made about seven years ago (and which has since become very common in Paris *), I heated a sufficient quantity of cold water, to make Coffee for the breakfast of two persons, and kept the Coffee boiling hot, one hour after it was made; with as much spirits of wine as cost *two sous*, or one penny English money.

A fire could not have been made with wood at a less expence to heat this water.

As the size of the flame of this lamp may be increased or diminished, at pleasure, by means of the rack which raises and lowers its circular wick, all the fuel which is consumed is usefully employed, and no heat is wasted in forming steam, when nothing more is wanted than the preservation of the temperature at which water is disposed to boil.

* I intend, if possible, to send one of these spirit lamps to England, with this Essay, in order that it may be put into the hands of some workman there, who may be disposed to imitate it.

In order to convey distinct ideas of the different parts of the apparatus necessary in making Coffee in the manner I have recommended, I have added the figure 1, which represents a vertical section (drawn to half the full size) of a coffee-pot constructed on what I conceive to be the very best principles. Its size is such as is most proper for making four cups of Coffee at once.

a—is the cylindrical strainer, into which the ground Coffee is put, in order that boiling hot water may be poured on it; when this strainer is filled with boiling water (after an ounce of ground Coffee has been properly pressed down on its bottom) the quantity of the liquid is just sufficient for making four cups of Coffee.

b—is the ground Coffee in its place.

c—is the handle of the rammer which is represented in its place.

d—is the reservoir for receiving the Coffee which descends into it from the strainer; and

e—is the spout through which the Coffee is poured out.

f—is the boiler, into which a small quantity of water is put, for the sole purpose of generating steam, for keeping the reservoir hot.

g—is the opening by which the water is poured into the boiler or out of it; this opening has a flat cover, which moves on a hinge, that is represented in the figure.

The

The boiler is of a conical form, and is enlarged a little at its upper extremity, in order to receive the cover which closes it above.

The reservoir and the boiler are fixed together above by foldering, so that the reservoir remains suspended in the boiler.

The cylindrical strainer is suspended on the upper extremity of the reservoir, by means of a flat projecting brim, about two-tenths of an inch broad.

b—is the hoop, made of sheet-copper, and perforated with a row of holes, on which the boiler reposes: a part of the bottom of the boiler is seen through these holes.

The reservoir is represented by dotted lines, in order the better to distinguish it.

The opening in the side of the boiler, by which the water enters it, is represented in the figure. This opening is covered by a part of the handle of the coffee-pot.

The diameter of the hoop *b*, on which the coffee-pot stands, should always be at least *six inches in diameter* whatever may be the contents of the coffee-pot; and the spirit lamps or portable furnaces, used with these coffee-pots, should always be *rather less than six inches in diameter above*, or at their openings, in order that the bottom of the coffee-pot may, in all cases, be set down properly on the six knobs belonging to the lamp or the furnace, which are destined to support it.

The figure 2. has been added, in order to shew how the same coffee-pot may be made to serve for making any number of cups of Coffee, within certain limits, that may be wanted, by being furnished with strainers of different sizes.

This coffee-pot has three strainers, the largest of which is cylindrical, and of a size proper for making either *five* or *six* cups of Coffee.

The second in size, is designed for making either *three* cups or *four* cups. It is composed of two tubes or cylinders, of different diameters, united together. The lower cylinder, which is one inch in length, and two inches and three quarters in diameter, is closed below by a perforated bottom, on which the ground Coffee is placed. The upper cylinder, which is united to it, is about three inches in length, and just wide enough to enter without difficulty, into the larger cylindrical strainer, on the top of which it reposes by means of a projecting brim, when not in use.

The smaller strainer, which is of a size proper for making *two* cups of Coffee, enters that last described, and reposes on it (when not in use). This strainer is also composed of two cylinders united together. That which is lowest is two inches and one eighth in diameter and one inch in height, closed below by a flat bottom, perforated with small holes. The other cylinder, which is united to it above, is of such a diameter as to enter the second strainer without difficulty, and of the height which

is

is necessary, in order that it may contain two coffee-cups full of water.

Each of these strainers has its separate rammer to ram down the ground Coffee placed in it, but one common handle serves for them all. This handle is screwed into the middle of a circular plate, which forms the principal part of the rammer.

The circular plate which belongs to each of these strainers, remains in it, when the coffee-pot is not in use, and the handle remains attached to the circular plate belonging to the smaller strainer.

When only *two* cups of Coffee are wanted, the two largest strainers being taken away, the smaller strainer is used alone.

If either *three* or *four* cups are wanted, the smallest and the largest strainers are taken away, and the other strainer is used.

When *five* or *six* cups are wanted, the largest strainer is used, and the other two are taken away.

If *seven*, *eight*, *nine*, or *ten* cups are wanted, *six* cups are first made with the largest strainer; when that strainer being removed, the remaining number of cups are made with the strainer next in size.

By making use of the three strainers one after the other, *eleven* or *twelve* cups of Coffee may be made in this coffee-pot, and as the heat always remains the same during the whole of the time employed in these operations, the Coffee is just as good as if the whole of it were made at once.

By adding two additional strainers to the coffee-pot represented by the figure 1. one of them of a proper size for making *one* cup of Coffee; and the other of a proper size for making *two* cups; this coffee-pot may be used for making either *one, two, three, four, five, or six* cups of Coffee.

All the coffee-pots that have been made of this size, have been furnished with these two additional strainers; but they were omitted in the figure, in order to render it more simple, and more easy to be understood.

Most of the coffee-pots of this size (figure 1.) have had their boilers made sufficiently capacious for heating the water necessary for making the Coffee, as well as that which is required for generating the steam which is employed for keeping the reservoir boiling hot.

This may be done in all cases; but when this method is employed, it will be necessary that the boiler should be furnished with a brass cock, placed about one quarter of an inch above the level of its bottom, in order that the boiling water necessary for pouring on the ground Coffee in the strainer may be drawn off, without removing the boiler from the fire. By placing this brass cock immediately under the handle of the coffee-pot, it may be so united to it as almost to escape observation. I have a coffee-pot of this kind, in which the brass cock, by which the boiling water is drawn off, is entirely concealed in the ornaments of the handle.

I have

I have another, in which the boiling water is poured out by means of a second spout, placed just opposite to that by which the Coffee is poured out ; but in using this coffee-pot, it is indispensably necessary to pour out *at once* all the boiling water that is wanted, and before any water has been put into the strainer.

When coffee-pots are made with two spouts, one for the water, and the other for the Coffee, the handle must be placed between them, and at equal distances from each of them.

I have caused a very beautiful urn to be constructed, with a concealed spirit lamp, which serves for heating water for making either tea or Coffee, and for making both tea and Coffee at the same time. It is represented by the figure 3, which is drawn to a scale of one quarter of the full size.

This urn is placed on what appears to be a block of black marble, seven inches square, and two inches and a quarter in thickness. This is made of strong sheet iron, japanned black, which serves for concealing a spirit lamp, on Argand's principles, which is employed in keeping the water in the urn boiling hot. The foot of the urn is hollow, and serves for concealing the chimney of the lamp.

It is perforated by two rows of small round holes, the one in the moulding at its lower extremity ; which serves for the admission of the air, which is necessary for keeping the lamp burning ; the other near the upper extremity of the foot where it is

united to the body of the urn, which serves as a passage for the escape of the vapour, which is generated in the combustion of the ardent spirits.

There is a large circular hole in the top of the square box (of sheet-iron), on which the urn is placed, which hole is covered and completely concealed by the foot of the urn.

This hole, which is five inches and a half in diameter, is the passage by which the lamp enters when it is placed in the square box : and by means of a rim about a quarter of an inch in width and five inches and a half in diameter, which is fixed to the lower part of the foot of the urn, and which enters the circular hole in the top of the box ; by turning round the urn to the left, one quarter of a whole revolution, the rim attached to the foot of the urn being in its place, the urn and the square box are locked together, in a manner similar to that which is used in fixing a bayonet to its musket ; and in taking up the urn by its two handles, the square box is taken up along with it, and remains firmly attached to it.

The size of the flame of the lamp is regulated, and the lamp is extinguished when no longer wanted, by means of a rack which moves the wick of the lamp up or down ; and this rack is moved by means of a horizontal rod of strong wire, which lies in a small groove made to receive it in the top of the square box. This wire has a small knob at the end of it, which projects just beyond
the

the side of the box ; and as both this wire and the knob at the end of it are painted black and japanned, they are little observed, and consequently do not produce any disagreeable effect.

Two brass cocks (which are not represented in the figure) are placed at the distance of about four inches from each other, at the level of the bottom of the reservoir which serves for containing the Coffee, when made ; one of these serves for drawing off the boiling water contained in the boiler, and the other for drawing off the Coffee ; and the words *Water* and *Coffee* are inscribed on their handles.

This urn has one large cover, nine inches in diameter, which closes the boiler without closing the opening of the reservoir for the Coffee, and which appears to form the upper part of the urn ; and another cover, about four inches and a quarter in diameter, which being made to fit into a circular hole in the top of the cover of the boiler, closes the reservoir, which contains the cylindrical strainer and the Coffee.

When the boiler is filled with boiling water both covers must be removed ; but the small cover only is removed when the ground Coffee is put into the strainer ; and when boiling water (which may be drawn out of the boiler) is poured on it.

The reservoir for the Coffee is firmly fixed in its place, in the middle of the boiler, by means of three short feet of strong tin (of about half an inch in height),

height), which are foldered to the reservoir, and to the boiler.

The form of the reservoir is conical, and it is about six inches in diameter below, four inches and one-tenth in diameter above, and seven inches and a half in height.

By using two or three strainers successively, *sixteen* or *eighteen* cups of Coffee may be made in this urn; and when the strainers are taken away, and the reservoir is quite filled with Coffee, it will hold more than *twenty* cups.

This urn has been found to be very useful for serving up Coffee after dinner to large companies; and it is the more so, as those who find their Coffee too strong can easily make it weaker, by mixing with it a little boiling water, which may be drawn from the boiler, which is always at hand.

The form of the boiler, and that of its large cylindrical strainer, are faintly represented in the figure by dotted lines.

The boiler must always be filled with water *already boiling hot*; for the lamp, though quite powerful enough to keep this water boiling hot, and even to make it boil with violence, does not furnish heat enough to heat so great a quantity of cold water, and make it boiling hot in any reasonable time.

As often as the smallest quantity of steam is seen to issue from the boiler, the flame of the lamp should be reduced, for no advantage whatever attends

tends the actual boiling of water, which is boiling hot; and it always occasions a very great loss of heat, and fills the room full of steam and of invisible vapour, which makes every thing in it damp and uncomfortable.

A considerable number of these Coffee urns have been made and sold at Paris within these last five or six years; some of them have been made of silver richly sculptured and ornamented by gilding. Several others have been made of copper and ornamented with copper plated with silver; these last, with their lamps, and a set of three strainers made of tin, have cost about six guineas. But the greater part of those which have been sold, have been made of tin; and they have in general been gilt so as to be entirely covered over on the outside with leaf gold, and this leaf gold covered by a coating of transparent varnish.

When so constructed and ornamented, they have cost four guineas with all their apparatus quite complete.

I cannot help flattering myself that they will find their way into England, and there meet with approbation. I shall never cease to be particularly desirous that my labours to improve the domestic arts may be found useful in that country.

The figure 4. represents a small urn with two short spouts and two handles, of a proper size for making one single cup of Coffee. It is drawn to a scale of half the full size. Its boiler contains

water enough to furnish what is required for making the Coffee, as well as that which is necessary for generating steam, for keeping the Coffee hot. The water descends below the foot of the urn into the flat plinth, on which it stands, and to which it is united.

The figure 5. represents an urn with two long spouts, which serve at the same time as handles. Its size is such as would be proper for making either *one* or *two* cups of Coffee. The strainer, which is represented by dotted lines, is of a proper size for making two cups.

Both these urns are destined to be heated over spirit lamps, or small portable furnaces.

It is hardly necessary that I should observe, that in case the forms of either of these urns should be thought inelegant, their sizes may, without any difficulty, be considerably augmented; but when spouts are used with large urns, they occasion a good deal of inconvenience.

As Coffee is very wholesome, and may be afforded at a very low price, especially in countries which have colonies where the climate is proper for growing it, many public advantages would be derived from the general introduction of it among all classes of society.

One most important advantage, which, on a superficial view of the subject, is not very obvious, would most probably be derived from it. As Coffee possesses, in a high degree, an exhilarating quality,
it

it would, in some measure, supply the place of spirituous liquors among the lower classes of the people.

Those who work hard, stand in need of something to cheer and comfort them, from time to time, and it is greatly to be lamented that the strong liquors now used for that purpose, are not only very unwholesome and permanently debilitating, both to the mind and the body, but that their operation is accompanied by a peculiar species of madness, which renders those who are under the influence of it very mischievous, and so lost to all sense of decency and propriety, as to become objects of horror and aversion.

The pleasing flow of spirits that is excited by Coffee, has none of these baneful effects.

Instead of irritating the mind, and exciting to acts of violence, it calms every turbulent and malevolent passion, and is accompanied by a consciousness of ease, contentment, and good-will to all men, which is very different from that wild joy and unbridled licentiousness which accompanies intoxication.

Coffee is not only very wholesome, but when sweetened with sugar, is very nourishing.

Sugar is supposed to be the most nourishing substance known. Its nourishing powers are even such, that the use of it has been recommended in fattening cattle.

An ingenious young man, Doctor ———, a physician, who resided in London, made a long course of experiments on himself, several years ago, with a view to determine the relative nutritive powers of those substances which are most commonly used as food by mankind, and he found that sugar was more nourishing than any other substance he tried.

He took no other food for a considerable time, than sugar, and drank nothing but water; and he contrived to subsist on a surprisingly small quantity of sugar. If my memory does not fail me, it was no more than two ounces a day.

It is much to be lamented, that this interesting young man should have fallen a sacrifice to his zeal in promoting useful science; but his health was so totally deranged by these experiments, which he pursued with too much ardour and perseverance, that he died soon after they were finished. All the resources of the medical art were employed, but nothing could save him.

As common brown sugar is quite as nourishing as the best refined loaf sugar, and as a great many persons prefer it for Coffee, it appears to me to be extremely probable that Coffee may be found to be one of the cheapest kinds of food that can be procured, and more especially in Great Britain.

Half a pint of the best Coffee, or two full cups, may be made with half an ounce of ground Coffee, which, if one pound averdupois weight of raw
Coffee

Coffee can be bought in the shops for twelve-pence sterling, will cost only *six-sevenths* of a farthing; and if a pound of brown sugar can be bought for one shilling, one ounce of sugar, which would be a large allowance for two cups of Coffee, would cost only three farthings; consequently the materials for making half a pint of Coffee would cost less than one penny.

As Coffee has a great deal of taste, which it imparts very liberally to the bread which is eaten with it, and as the taste of Coffee is very agreeable to all palates, and the use of bread greatly prolongs the duration of the pleasure which this taste excites, a very delicious repast may be made merely with Coffee and bread, without either butter or milk.

The taste of the Coffee predominates in such a manner, that the butter would hardly be perceived, and might be omitted without any sensible loss. But I acknowledge, that in my opinion, the addition of a certain quantity of good cream or milk to Coffee, improves it very much. Milk, however, is not a very expensive article in Great Britain; and if the butter be omitted, which is by no means necessary, (and is even unwholesome,) a good breakfast of milk Coffee might be provided for a very small sum.

What a difference between such a breakfast, and that miserable and unwholesome wash which the poor people in England drink under the name of *tea*!

All

All the Coffee that can be wanted, may be had in the British colonies, and paid for in British manufactures; but tea must be purchased in China, and paid for in hard money.

These are circumstances which ought, no doubt, to have great weight, especially in such a country as England, where all ranks of society are equally sensible of the advantages of their distinguished situation, and equally anxious to promote the public prosperity.

There are some difficulties, no doubt, in changing the habits of a nation, but these difficulties have been too much exaggerated, and they have too often been an excuse for indolence.

If any thing really useful be proposed to the public, it can hardly fail to be adopted, if it be properly recommended; but so many new things, unworthy of notice, are every day proposed, that it is by no means surprising that little attention is paid to such recommendations.

Many useful improvements have been proposed by ingenious and enlightened men, which have failed, merely because those who have brought them forward have neglected to give directions sufficiently clear respecting the details of their execution.

I have been so much persuaded of that important fact, that I have perhaps sometimes erred on the other side, and taken up too much time in describing things, in all their most minute details, which many persons would be able to comprehend at once,

once, and almost without any description; but I have done that which I thought most likely to render my labours useful.

I never write, except it be to recommend to the public something which I conceive to be of importance, or to communicate the results of new experimental researches, which appear to be sufficiently curious and interesting to merit attention; and it must, I think, be quite evident to those who read my writings, that I have never hesitated to sacrifice to perspicuity, not only every ornament of style, but also every brilliant idea which, by getting too strong hold of the imagination, might distract the attention.

The reader must condescend not only to go with me frequently into the humblest walks of private life, but also to examine the various objects that present themselves, with the greatest care, and in all their most minute details.

But I must hasten to put an end to this Essay, which has already exceeded the limits to which I had hopes of being able to confine it. Being anxious that it might be read by many persons, (as I thought that it would be very useful,) I felt the necessity of making it as short as possible. I shall conclude with a few observations on the means that may be employed for rendering the use of Coffee more general among the lower classes of society.

In the first place, the method of making *good Coffee* must be known; and the utensils necessary in

that process must be so contrived, as to be cheap and durable, and easy to be managed.

It will be in vain that the laws are repealed which laid restrictions on the free use of Coffee, as long as the great mass of the people remain ignorant of its excellent qualities; they will be little disposed to substitute it in the place of another beverage, to which long habit has given them an attachment.

As long as Coffee shall continue to be made according to the method generally practised in England, I shall have no hope of its being preferred to tea, for its qualities are so inferior when prepared in that way, that it is hardly possible that it should be much liked.

The utensils which I have recommended for making Coffee, though some of them are sufficiently simple to be afforded at a low price; yet, as they are contrived to be used with spirit lamps, or with portable furnaces, which must be heated with charcoal, they are not well calculated for the use of those persons who inhabit the rooms in which they cook their victuals; and of many others, who though they may have separate kitchens, may not find it convenient to use spirit lamps and portable furnaces.

For the use of such persons, the coffee-pots represented by the figures 1. and 2. may be made to answer perfectly well, merely by taking away the perforated hoops on which they stand. For, when these are taken away, these coffee-pots may be heated
over

over a common chimney fire just as any common coffee-pot is now heated.

For very poor persons, who cannot afford to buy a coffee-pot, I shall recommend a very simple contrivance, by means of which Coffee may be made, and even in the highest possible perfection. —I have often made use of this contrivance in making my own breakfast, and I have not found the Coffee to be in the least inferior to that made in the most costly and complicated machines.

This little utensil is distinct'y represented in the figure 6. which is drawn to a scale of half the full size.

The whole of this apparatus consists of a coffee-cup, which should hold about three quarters of a pint; and a strainer, made of tin, which is suspended in it by its brim.

This coffee-cup should be cylindrical, and when employed in making one gill of good strong Coffee, should be three inches in diameter within, and three inches and a half deep. The lower part of the strainer is one inch and a half in diameter, and one inch deep; and the upper part of it two inches and nine-tenths in diameter, and about one inch and a half in depth.

The water which is poured on the ground Coffee should be boiling hot; the cup and the strainer having both been previously heated, by dipping them into boiling water.

As the Coffee will not be more than eight or ten minutes in passing through the strainer, it is probable that it will be quite as hot as it can be drank, after it has descended into the lower part of the cup; but if it should be necessary to keep it hot a longer time, the cup may be placed in a small quantity of boiling water, contained in a small saucepan, or other fit vessel, placed near the fire.

When all the Coffee has passed into the lower part of the cup the strainer may be taken away, and the cup may be covered with the cover of the strainer.

I do not think it possible to contrive a more simple apparatus than this for making Coffee, nor one in which Coffee can be made in higher perfection.

That represented by figure 7., which is of a size proper for making two cups of coffee, is equally simple; and as it may be made entirely of pottery, it would cost a mere trifle, perhaps not more than a shilling.

The cup, which serves in two capacities, first as a reservoir in making the coffee, and then as a cup in drinking it, (and which, in a family, may be used for other purposes,) is three inches and a half in diameter, internally, and four inches deep.

As many persons may prefer coffee-pots made entirely of Staffordshire-ware, porcelain, or other pottery, to those made of the metals, not only on account of the low prices at which they may be

afforded, but also on account of their superior neatness and cleanliness, I have added the figure 8., which, on a scale of half the full size, represents a coffee-pot made of pottery, of a size proper for making five or six cups of coffee at once, or three, four, five, six, seven, or eight cups, if two strainers are used, one after the other.

When this coffee-pot is used, it will be necessary to place it in boiling water to keep it hot, and it will be useful to cover the whole with a cylindrical vessel turned upside down; by which means both the strainer and the coffee-pot will be surrounded by hot steam, which will contribute very essentially to the goodness of the Coffee.

As soon as the Coffee has passed into the coffee-pot the strainer may be taken away; and the coffee-pot covered with the cover, which is common to it, and to the strainer.

I shall conclude by a few observations, on the means that may be used for preserving ready made Coffee, good for a considerable time, in bottles.

*How to
preserve Coffee
ready-made*

The bottles having been made very clean, must be put into clean cold water, in a large kettle, and the water must be heated gradually, and made to boil, in order that the bottles may be heated boiling hot.

The Coffee, fresh prepared and still boiling hot, must be put into these heated bottles, which must be immediately well closed with good sound corks.

The

The bottles must then be removed into a cool cellar, where they must be kept well covered up in dry sand, in order to preserve them from the light.

By this means ready-made Coffee may be preserved good for a long time, but great care must be taken not to let it be exposed to the light, otherwise it will soon be spoiled.

When wanted for use the Coffee must be heated in the bottle and before the cork is drawn; otherwise a great deal of the aromatic flavour of the Coffee will be lost in heating it. And in order that it may be heated in the bottle, without danger, the bottle must be put into cold water, and this water must be gradually heated till the Coffee has acquired the degree of heat which is wanted. The cork may then be drawn, and the Coffee poured out, and served up.

As good Coffee is very far from being disagreeable when taken cold, and as there is no doubt but it must be quite as exhilarating when cold as when it is taken hot, why should it not be made to supply the place of those pernicious drams of spirituous liquors, which do so much harm?

Half a pint of good cold Coffee, properly sweetened, which would not cost more than half a pint of porter, would be a much more refreshing and exhilarating draft; and would no doubt be incomparably more nourishing.

How much then must it be preferable to a dram of gin!

The

The advantages and disadvantages to agriculture and commerce, which would arise from the introduction of a new beverage for supplying the place of malt liquors and ardent spirits distilled from grain ; must be estimated and balanced, by those whose knowledge of political economy fits them for determining these most intricate and important questions.

END OF THE EIGHTEENTH ESSAY.



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Fig. 1.

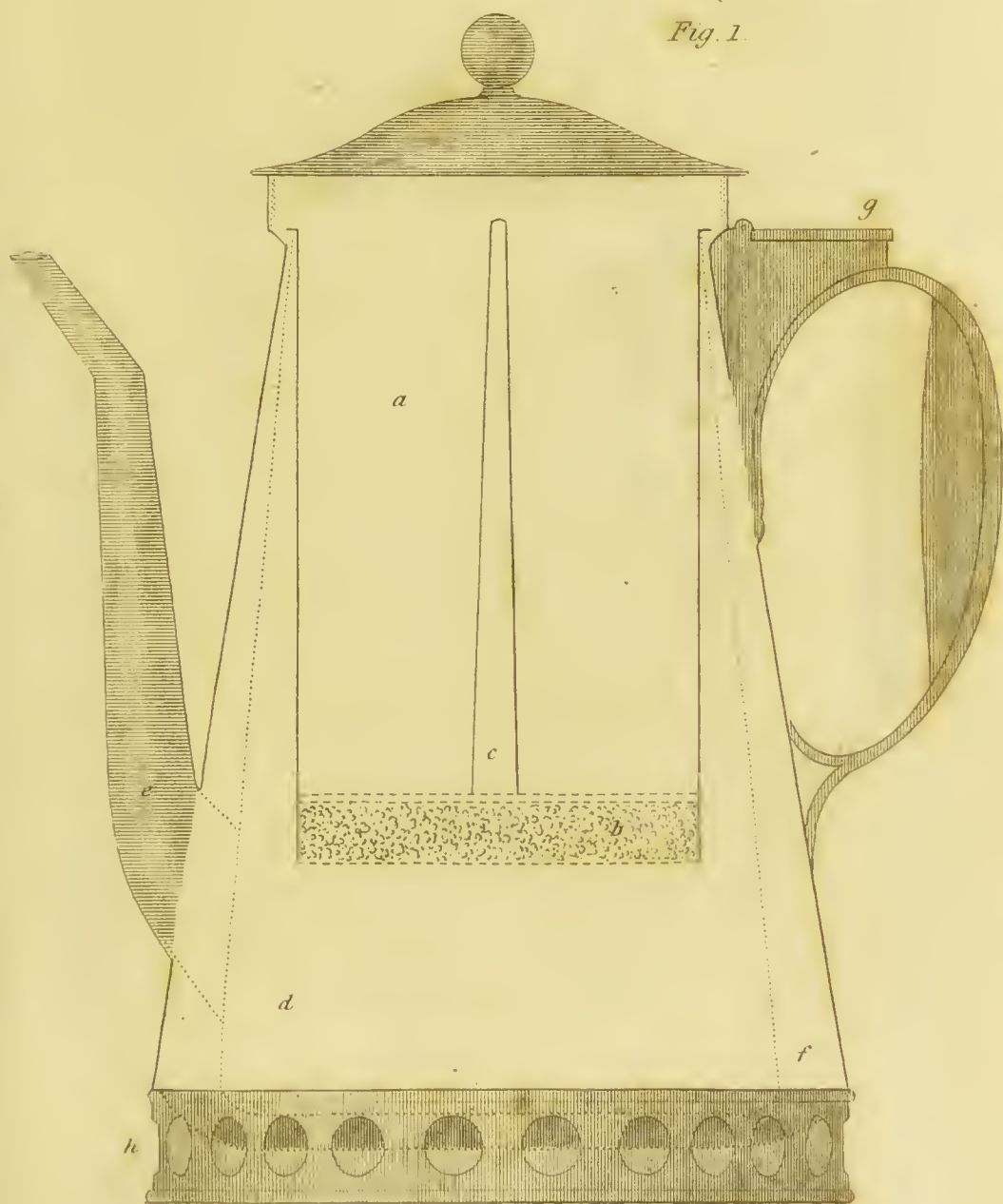


Fig. 2.

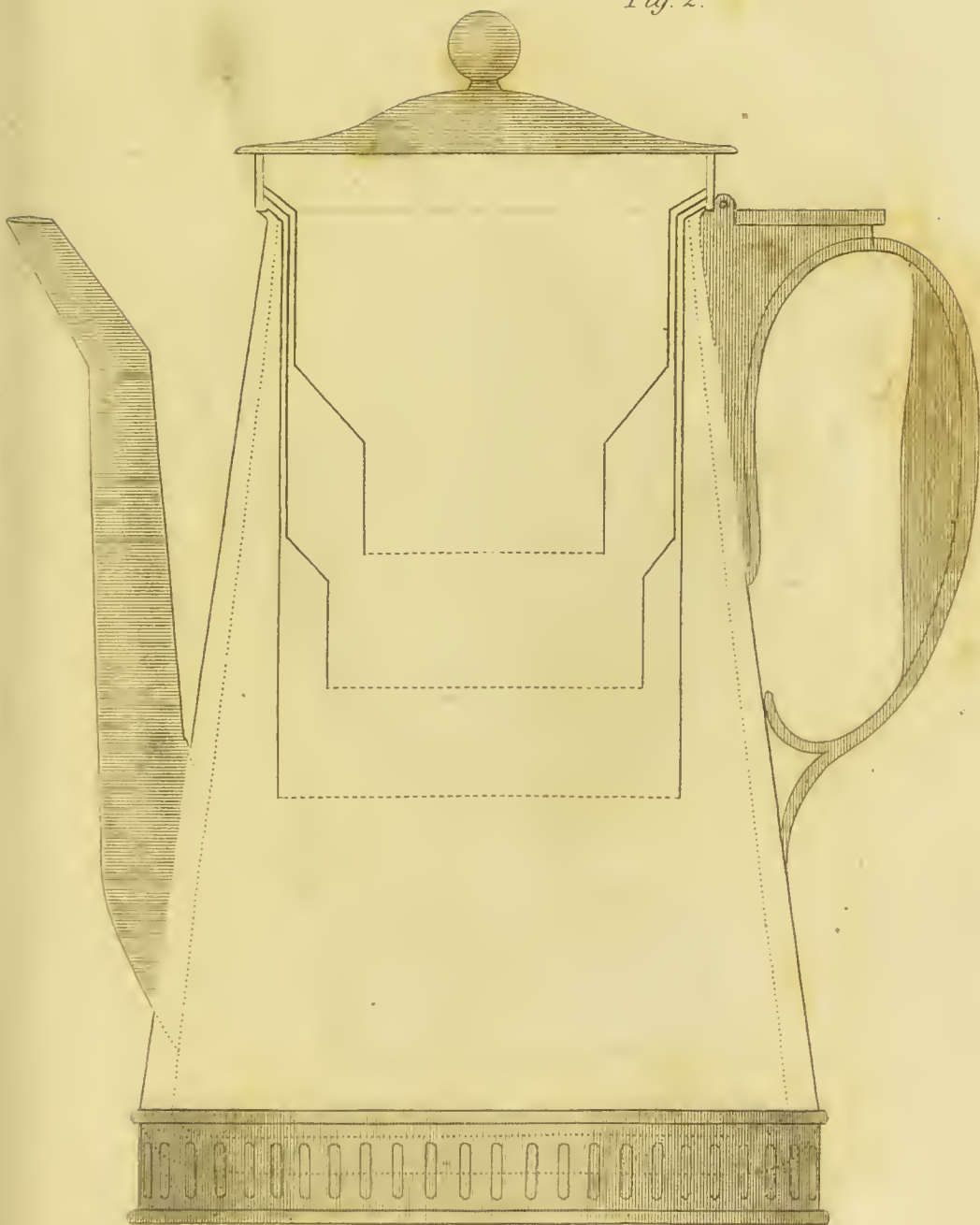


Fig. 3.





Fig. 4.

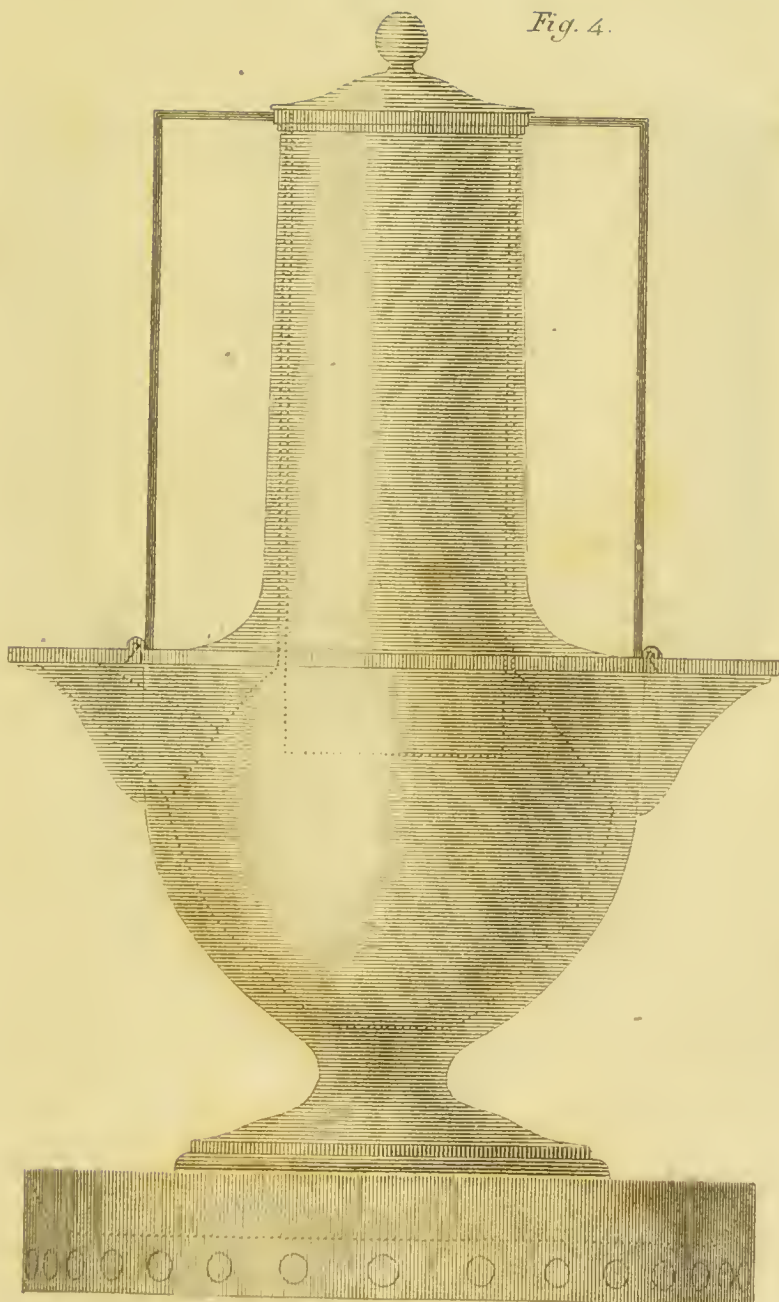


Fig. 5.

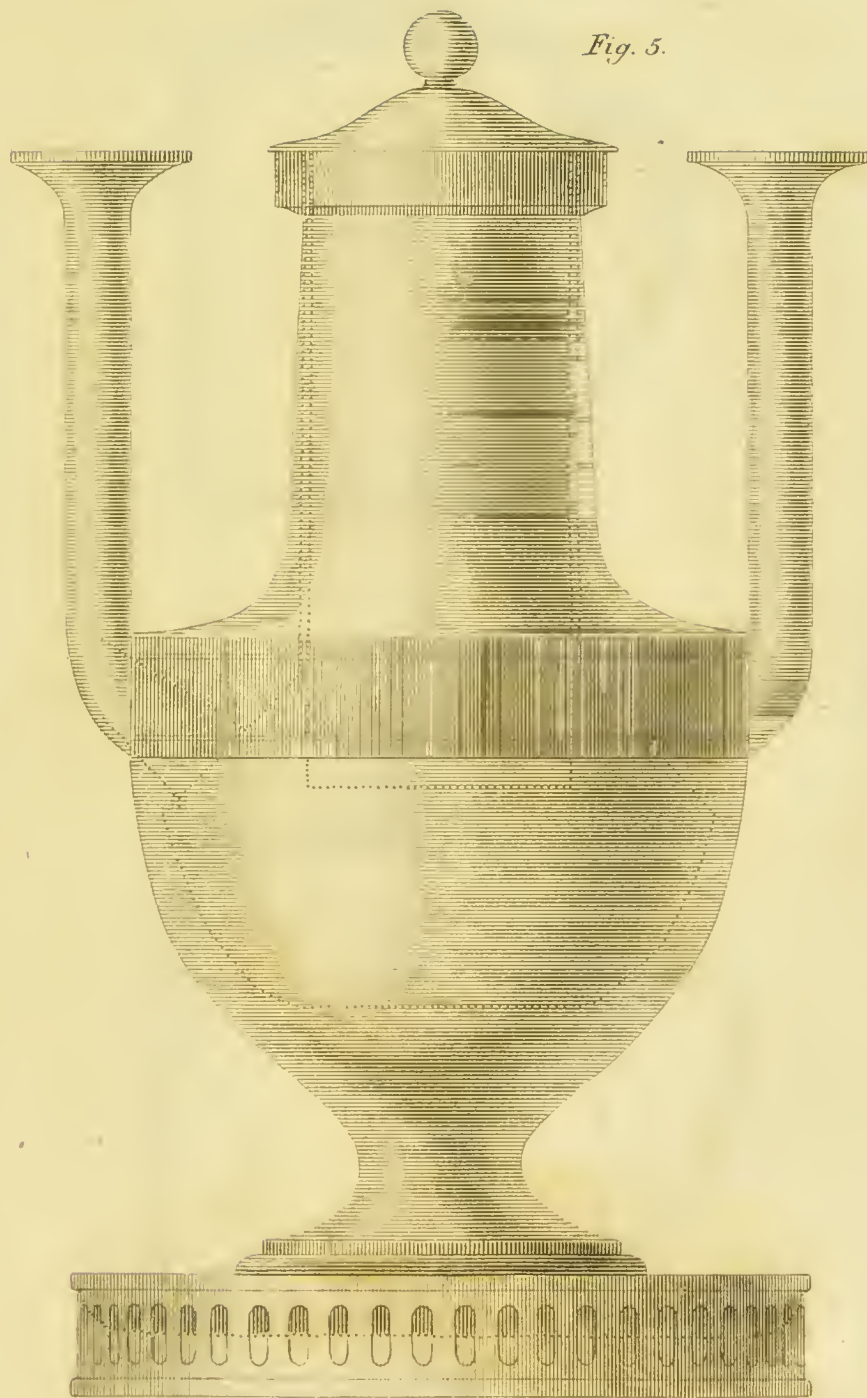




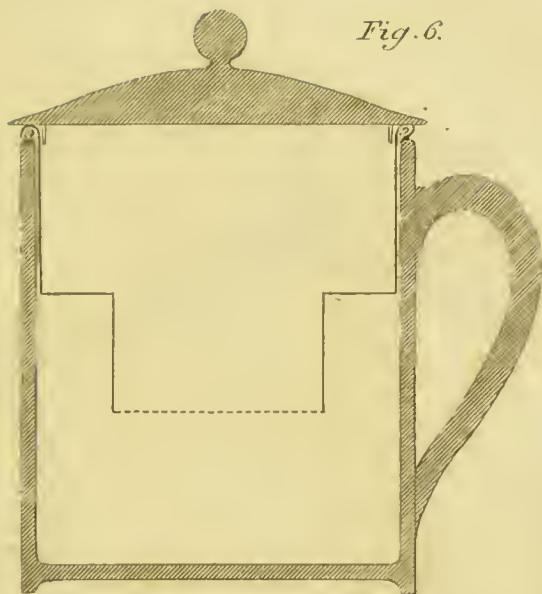
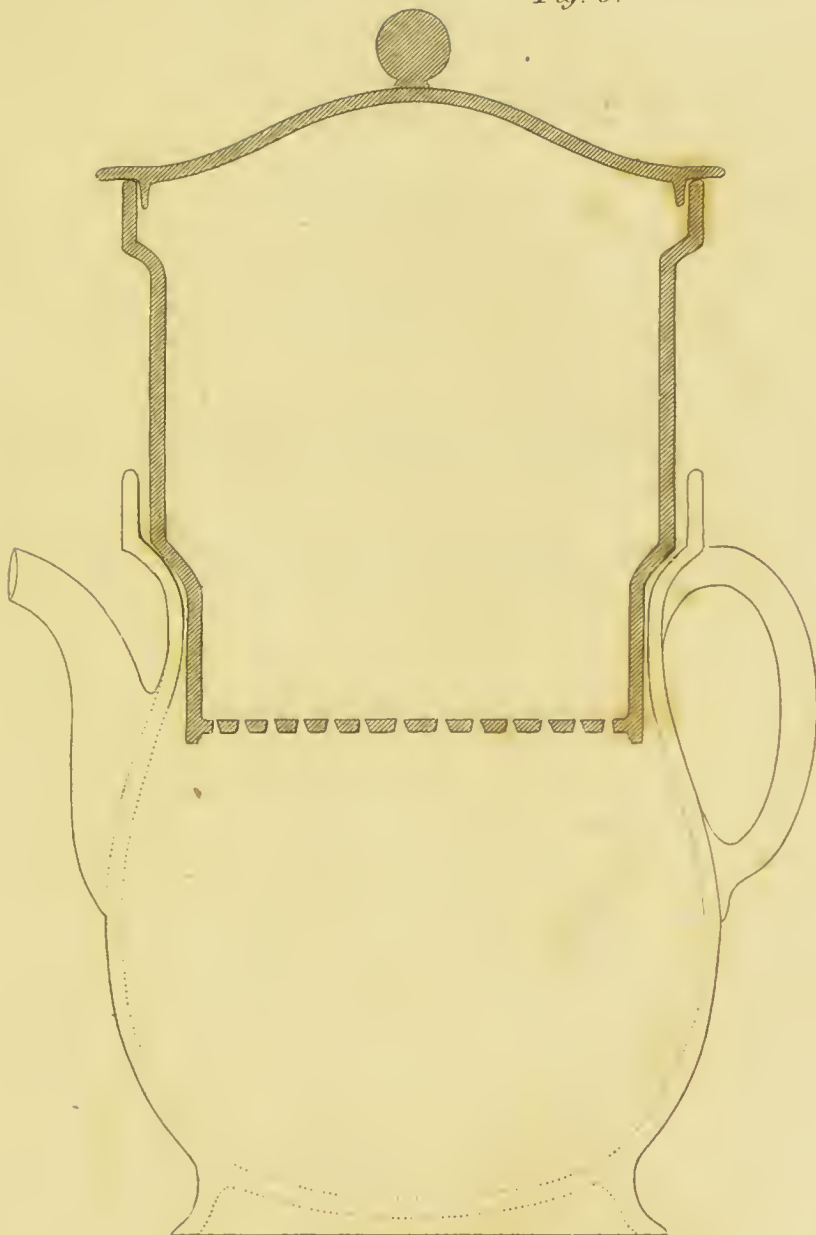
Fig. 6.*Fig. 7.*



Fig. 8.





HINTS

ON THE

PROCESSES OF WINE-MAKING.

By Dr MUCCULLOCH, Woolwich.

In a Letter to Mr NEILL,
Secretary of the Caledonian Horticultural Society.

[1818]

HINTS, &c.

IN compliance with the wishes of some of the members of the Caledonian Horticultural Society, I have attempted to sketch the general principles and practices used in the manufacture of wine, with a view of assisting the efforts of those whom the Society, by its annual premiums, has encouraged to cultivate the art of making this liquor from fruits of domestic growth.

In laying down these rules, and in describing these usages, I have been chiefly careful in selecting, and solicitous in enforcing, those which could most readily be brought to bear on our domestic manufacture; being desirous rather to point out such analogies as were applicable to the practices which the Society has so laudably patronized, than to enter either into the chemical history of this most interesting process, or to give a detailed



Memo. Caled. Hort. Soc.

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account of the art, as it is practised in those more favoured climates, where the grape is the sole fruit in use for this purpose. The magnitude of the subject, would have otherwise led me into discussions, of a length incompatible with the limits of the Society's publications. In condensing and abridging the materials originally collected for this purpose, I have perhaps reason to fear that I have omitted matters essential to the perfect understanding of this subject. Yet I hope that I have not neglected any thing which will prove a material want, in reducing to practice the views which I have held out, and that some light, however feeble, will be afforded to those, who have hitherto been guided by rules of a dogmatical and positive nature.

It is evident that, in the complicated process of fermentation, some rules should be laid down as the foundation of our proceedings, and the test to which we must have recourse in examining the accuracy of our manipulations. I cannot too strongly enforce the necessity of familiarizing ourselves with *general principles*, which alone can assist us through the obscure paths, which this, as well as every art connected with chemistry, is obliged to pursue. And it is the address displayed by the artist in converting these general principles to his changing processes, that will give him a certain pre-eminence over those who are governed by invariable rules. In fact, however these

rules may appear fixed, they cannot be generally applied, because, under the mutable circumstances in which the application is made, they must frequently be rendered futile, and sometimes even injurious.

The constituent parts of the fruits used in the experiments now under consideration, are malic acid, either in a state of purity, or one of combination with potash, (a circumstance not yet perfectly ascertained); vegetable mucilage, or extractive matter; supertartrite of potash; sugar; water; the sweet principle; the colouring principle; tannin; super-oxalate of potash; and the principle of flavour. The proportions of these, vary much in different fruits, and it sometimes happens that one or more of them is entirely absent. In the white currant for instance, the colouring substance is often deficient; whilst it abounds in the elder-berry and red grape. So the super-oxalate of potash is rarely found; and, on the contrary, those salts to which the tartarous, or malic acid appertain, are more frequent. So likewise, the sugar is much less abundant than the sweet principle, which is indeed the general cause of the sweetness of the greater number of our fruits. The vegetable mucilage is, if any, the only principle whose presence is invariable; and this principle is one of the most essential in the fabrication of a vinous liquor, as we shall see hereafter. The main diversities of character, in the products of the various fruits, is owing to the varying pro-

portions of the several ingredients which they contain. It is true, that difference of management may produce different effects ; but no contrivance can give to the gooseberry the constituent elements of the grape, nor can any mode of procedure extract the flavour of champagne from the juice of gooseberries, although many, who have not been much accustomed to the flavour of the foreign wine, have been deceived by that made from our humble fruit.

Among the principles enumerated, tartar, water, sugar, the sweet principle, and the vegetable extract or mucilage, are the most essential in the conversion of fruits into wine. Colour and flavour may be considered as adventitious ; and the principles which yield them, are in nowise essential to the process of wine-making. The effect produced by the super-oxalate of potash is unknown, as it has not been the subject of experiment.

Tartar, however, seems essential to the formation of a genuine vinous liquor ; and an addition of it where it is naturally wanting, is found, not only to ameliorate the produce, but even to increase the quantity of alcohol, which a given proportion of sugar and the vegetable extract is capable of producing. Fermentation is more easily induced where this salt is present ; and the experiments of some of the French Chemists, seem to shew that it is decomposed during this process. Their opinion, that it

is converted into the malic acid is questionable. The presence of tartar is the circumstance which most strongly distinguishes the grape from all the fruits which have been applied to the making of wine. In this fruit, it exists in the greatest quantity before ripening, and a portion of it disappears during this process. From this peculiarity of the grape, the practice has been introduced of mixing tartar with those washes, which makers of *sweets* intend for the basis of their wines; and from it I have also derived the practice of mixing tartar with those native fruits which are deficient in this substance; a practice which has been attended with the best results. The details of this practice will be treated of hereafter in their proper place.

The effect of the *malic acid*, another of the enumerated ingredients in fruits, is very different from that of tartar, inasmuch as it has been found injurious to the fabrication of wine. It is remarked, that all wines which abound in malic acid are of a bad quality, although in many cases it has not been determined, whether this acid was an original ingredient in the fruit, or whether it was not generated during the process of fermentation.

In either case, since its existence in wine is found to be injurious, it is important to attend to this fact, as our native fruits seem all to be characterized by an excess of malic acid. This is perhaps one of the most fundamental and least corrigible defects in our domestic wines. To render the nature of this

defect more obvious, it must be remarked, that the essential distinction between cider and wine, consists in the quantity of malic acid which enters into the composition of the former. From this cause our native wines are more apt to partake of the nature of cider than wine, although these are often rather disguised than changed by the predominance of undecomposed sugar, of brandy, and other foreign matters which enter into their composition.

It is a question, worthy of consideration, whether some chemical means might not be adopted for destroying a portion of this acid, either before or after the process of fermentation. In the manufacture of sherry wine, lime is added to the grapes before this process is commenced. However empirical this practice may be among the manufacturers, it probably acts by neutralizing this acid, as well as a portion of the tartarous acid, and to this is probably owing the peculiarly dry quality of that wine. A hint may probably be borrowed from this practice towards the amelioration of our domestic wines; and I may here venture to point it out as a practice worthy of imitation,—worthy at least of a careful trial. It is only from the results of such, and similar experiments, that we can hope ever to place our domestic manufacture on a sound and rational basis.

Of all the substances which are called into action, during the process of wine-making, *Sugar* must be considered the most essential, being that

on which the strength of the wine depends. Those fruits which contain the greatest proportion of sugar, furnish the strongest wine; the alcohol generated in the act of fermentation, being always found to bear a proportion to the pre-existing sugar. The principal defect in our domestic fruits is the small proportion of sugar which they contain; but it is at the same time that which we are most easily able to remedy; and it is on this basis indeed that the whole system of our domestic wine manufacture is founded. But even in this part of the process, difficulties occur, and lead to the imperfect fermentation of these wines, and the consequent sweetness by which they are too often characterized. The saccharine matter has indeed been considered as existing in two distinct states in vegetables, that of pure sugar and that of the sweet principle; but it is perhaps more correct to consider sugar as an artificial substance formed by chemistry from the sweet principle, the only state in which sugar truly exists in vegetables. The sweet principle is characterized by its want of tendency to crystallize, and by the facility with which, on the addition of water, it runs into fermentation. Sugar, on the contrary, is crystallizable, and has no tendency to ferment, except in as far as it contains a portion of the sweet principle, or of that peculiar substance by which this principle is distinguished from sugar. If a solution of pure sugar in water be allowed to repose, it

crystallizes without fermenting ; nor does even the residuary syrup, or mother water as it may be called, undergo this process. But if it has been imperfectly refined, the remaining syrup, will, after the deposition of the crystals, contain so large a proportion of the sweet principle, that it will readily run into fermentation ; an accident well known to confectioners. The juice of the sugar-cane readily allows of the separation of the sugar from the sweet principle, and has hence become the almost exclusive subject of this manufacture. The residuary matter, known by the name of Molasses, is the sweet principle of the French Chemists, and is a peculiar compound of sugar, with vegetable extractive matter, similar to that which exists in the generality of sweet fruits. In considering this substance, therefore, it will be most consistent with the accuracy of chemical language, to speak of it as a peculiar compound of sugar and vegetable matter, and not to consider it, with Deyeux, Proust, and Seguin, as a simple substance. Hence we should not say with these chemists, that in some fruits, and in some varieties of the grape, sugar predominates, and in others, the sweet principle ; but that the sugar of the fruit is in some cases combined with more, and in others with less of the vegetable extract. These varying proportions of the two substances under consideration, are the cause of the various effects, which are observed in the results of fermentation in different fruits. If

the sugar predominates, the wine will be sweet, unless expedients are used to complete the fermentation of the sugar, and convert the whole into wine. If the sweet principle is most abundant, or, to speak more correctly, if there is much vegetable extract combined with the sugar, the fermentation will be complete, and the wine dry, unless artificial means, hereafter to be described, are used to prevent this effect. The distinction which I have here drawn, though appearing to partake of unnecessary refinement, will be found to lead to practical utility.

Among the enumerated ingredients of fruits, the *vegetable extract* naturally falls next under consideration. Although this substance has not been analyzed, we know that it differs from mere vegetable mucilage, by containing azote, or a substance which on decomposition produces it, since azotic gas has been detected in the produce of fermentation, both in an uncombined state, and in one of its most frequent combinations, forming ammonia. These substances are known to exist in yeast, which is a modification of the vegetable extract. In many vegetables, and conspicuously in the gluten of wheat, it exists in great proportion. It is for this reason that wheat as well as rye, act powerfully as ferments. It is also found in many flowers, in that of the elder for example,—in the leaves of the vine,—in the

grape,—in the gooseberry, and in many other fruits as well as leaves. It is observed to abound in those vegetable juices which gelatinise on boiling. This substance, then, is the true natural leaven of fruits, or that by which the sugar which they contain, is rendered capable of undergoing fermentation : And in the artificial process of vinification, which is the subject of this paper, it is to this substance that we must look for the conversion into wine of that sugar which may enter into the compound. But I shall have occasion to enlarge on this subject, when I consider the process of fermentation.

Water, enumerated among the principles of fruits, simple as it may appear, is a substance requiring consideration. If the proportion of water be too small in the liquor subjected to fermentation, that process is difficultly either established or maintained. This is a matter of constant occurrence in those countries, where the juice of the grape is boiled to a certain consistence, or where the fruit before pressing, is allowed to undergo a partial desiccation. From these practices, result sweet and half-fermented wines, those of Cyprus and other places, as well as that class of wines known in Italy by the name of *Vino cotto*. The *vina cocta* of the antients, appear to have been of a similar quality from the same cause. The wines of Tokay and San Lucar, are known to derive ad-

ditional richness and strength, from a moderate use of this practice. This process can be of no use in the manufacture of our domestic wines, nor does the nature of our fruits admit of it. An excessive addition of sugar may produce a similar effect ; but I know not that any of the receipts in use, approximate to that excess. That sweetness which is the prevalent fault of our wines, arises from other causes, which I shall consider hereafter.

The fruits of this country possess so little of the three remaining substances, which were enumerated as constituents, that it is unnecessary to dwell much on them.

Scarcely any *colour* is contained in our fruits, if we except the black cherry and the elder-berry, and as colour may be considered in the light of an ornament, and is easily procured by colouring ingredients, its want is not to be regretted ; the essential parts of wine-making in nowise depend on it.

The *tanning principle*, which is the cause of astringency, is contained in the husks and stems of some grapes, and communicates at the pleasure of the operator, that roughness known in Port wines. The sloe and damson possess it, but as it can readily be communicated by kino or catechu, and is not a very desirable quality, it is sufficient to have noticed it, considering, as we may, the imi-

tation of foreign wines by circuitous means, as a fruitless attempt.

The last principle, that of *flavour*, is so uncertain and fugacious, that it is difficult to establish any general rules respecting it. In many grapes, as those of Frontignan, the flavour of the fruit is absolutely identified with the wine which they yield ; but in all such cases the wine is sweet and half fermented. The finer flavours of the superior wines, those of claret, hermitage and burgundy, bear no resemblance to that of the fruit, but are the result of the vinous process. In the manufacture of many wines, recourse is had to flavouring ingredients, such as orris-root, grape-flowers, almonds, mignonette,—a process which is imitated in this country in the making of elder and cowslip wines. If the flavour of fruits could be transmitted with certainty to the wines, we might expect similar results from the strawberry and raspberry ; but the effect of fermentation is generally such as to volatilize or destroy this delicate principle. Hereafter I shall point out a probable method of attaining this object.

If a knowledge of the circumstances which attend and modify the intricate process of *fermentation*, be necessary in the making of wine from the grape, it is still more requisite to investigate the various accidents and causes which may affect it, when the substances exposed to its action, are, like

those used in our domestic manufacture, artificially compounded. It is thus only that we can hope to establish such general rules, as may be applicable to those ever-varying cases, where particular rules of practice would be unattainable. A general notion has already been given of the substances, to whose mixture the process of fermentation is owing, and the essential ones will be found to consist of sugar, vegetable extract, tartarous and malic acid, and water. These are indispensable, and to their varieties in proportion, some of the most remarkable differences in the results of fermentation will be found owing. Among these, sugar is the most essential, since the alcohol of wine is more particularly derived from the decomposition of this substance. The strength of the wine is proportioned to the quantity of sugar fermented, and the most saccharine juices, therefore, afford the strongest wine, or in the artificial process, if so it may be termed, that compound to which the greatest proportion of sugar has been added, will be capable of giving the strongest, if duly managed. But we have already seen, that sugar and water alone do not ferment, if the sugar be pure, and that this process only takes place in clayed sugars, or in those which contain a portion of that vegetable extract which characterizes the sweet principle. In the juices of fruits, the sugar and extract exist in a state of combination, to which, as I before remarked, the term of Sweet Principle has

been applied. If the juice of the grape, for example, be exposed to heat and rest, a coagulable substance is separated. The juice then ceases to ferment with the same facility, but may again be induced to undergo that change, by a re-addition of a matter similar to that which was separated from it. This matter is found in all vegetables, in some, as in wheat, conspicuously ; and it appears to constitute the greater proportion of yeast, as well as of the lees of wine and beer, or other fermented fluids. Here, then, we have the theory of this process, as it is applied to artificial compounds. It consists of mixing with a solution of pure sugar in water, a certain proportion of this unknown substance, which, to distinguish it from common yeast, I shall hereafter call by the name of *leaven*. It is on the proportion, quality and management of the leaven, that the most important consequences in vinification depend. I must therefore describe at more length, the various modes under which it appears.

The natural leaven of fruit, is coagulable, and partially separable by heat, but it is not entirely rendered inert. From this cause, as well as from the partial dissipation of the water and concentration of the sugar, boiled juices produce a sweet wine, the process of fermentation being rendered incomplete by a partial separation of the leaven. When the process of fermentation is suffered to proceed in any of the natural compounds formed in the

grape or other fruits, a portion of the leaven is separated from the wine, and is exhibited in two forms of yeast and lee, part rising to the surface in froth, and the remainder subsiding to the bottom of the vessel. It is essential to attend to this distinction, and to understand the true nature of these substances, as some of the most important practices in wine-making depend on it. I must add, that it still remains uncertain, whether any portion of the leaven enters into combination with the vinous produce, or whether it acts solely by exciting the requisite changes in the sugar, and is then finally and entirely separated. The yeast and lee form the artificial leaven, which, in some important particulars, differs from the natural. It is soluble in hot water, whereas the natural is not. But it is insoluble in cold, and it is thus separated by the act of fermentation. I may add, that, notwithstanding the numerous experiments to which yeast has been subjected, its composition, like that of many other vegetable matters, remains obscure. It is important, however, to recollect, that it contains ammonia, or at least the principles of this substance, as Proust has shown. Those who have been engaged in the manufacture of domestic wines, must know, that one of the most frequent defects of these wines, is an ammoniacal taste; and there is little reason to doubt, that it arises from some mismanagement in the process of fermentation, or an improper introduc-

tion of artificial leaven. Although I cannot point out a precise remedy for this evil, these remarks may perhaps turn the attention of wine-makers to search for one.

It will from these considerations be evident, that if certain proportions of sugar and of leaven, whether natural or artificial be taken, and the process of fermentation be suffered to proceed to its natural termination, the result will be a fluid perfectly vinous, containing neither sugar nor acid, and analogous either to beer or to wine, according to other circumstances hereafter to be considered. If the proportion of leaven be deficient, the produce will contain unchanged sugar; and the same effect will take place, if the fermentation be prematurely stopped by artificial means. If, on the contrary, the leaven is in excess, or the fermentation has been designedly protracted by artificial means, a new product will be formed, and the whole, or a portion of the alcohol, will disappear, and acetic acid will be found in its place. Sweet wine, therefore, is an imperfect wine, or one in which the leaven has borne so small a proportion to the sugar, as to have been incapable of converting the whole into a vinous liquor. This is the case with our domestic wines, when a large quantity of sugar is added to so small a proportion of fruit, that the compound does not contain natural leaven enough to convert the whole into wine. This evil may be corrected by the use of

the artificial leaven *yeast*, but the quantity added is generally inadequate to this object. It is from this cause, that the makers of domestic wines so often attempt in vain to produce dry ones. When this is attempted by diminishing the sugar, the result is a liquor both feeble as a wine, and at the same time, tending strongly to the acetous fermentation. If, on the contrary, recourse is had to an increase of the yeast, the consequence is an increase of the bad flavour, which this substance almost invariably communicates. The true remedy, is so to balance the vegetable juice and the sugar, as to produce a fluid analogous to the juice of the grape, or one in which there shall be a proportion of natural leaven, sufficient to convert the whole of the sugar into wine. Where a sweet wine is desired, this caution is not necessary. I shall hereafter shew how wines even of this quality can be procured from such a fluid, by an artificial suspension of the fermentation. I cannot too strongly caution the artist against the use of the common and pernicious practice of exciting the fermentation, by the yeast of beer. I have already made it appear, that when a due proportion exists between the leaven and sugar, either in a natural or artificial fluid, a regular fermentation takes place, and a perfect conversion of the whole into wine. It is therefore unnecessary to add yeast to a fluid properly compounded ; and it is further injurious, since the use of this substance not only communi-

cates the bitter flavour which it derives from the hop, but a peculiar and nauseous taste, apparently derived from its ammoniacal quality. It is well known to brewers, that a single spoonful of putrid yeast, will spread its contagion through many tuns of beer. If an artificial yeast is ever wanted, it may be found in the lees of wine, in which it is mixed with tartar, or else it may be reserved from the fermentation of former parcels of domestic wines. But a proper management of the fermentation itself, may be made to supply the want of natural leaven. I have already shown, that this leaven is rendered insoluble by the act of fermentation, and that it partly rises to the surface, and partly falls to the bottom of the fermenting fluid. By restoring this separated matter, the process may be protracted at pleasure, till the wine has acquired the degree of dryness that may be desired. It is only necessary for this purpose to break the *head*, and disperse it through the fermenting fluid, or to agitate the whole in such a way, as to mix the lees and scum with it, until the desired effect is produced. The apparently obscure process of rolling wine, or of returning it on the lees to *feed*, as it is technically called, is founded on this principle; it renders the wine stronger and better, by re-exciting the languid fermentation. The converse of this practice will be equally intelligible. If a sweet wine is desired, the fermenting process may be at any time artifi-

cially suspended, by separating the wine already produced from the ferment with which it is mixed. The operations in use for this end, consist in decanting, in clarifying by means of glue or albumen, or in the use of certain chemical substances which decompose the leaven ; processes which I must consider more at length hereafter. From this view, it will be easily deduced, that sweet wines cannot turn sour, because their leaven has been expended. Another remark of equal importance may also be deduced, that all wines will have this tendency, if the whole of the sugar of the fluid has been converted, and if at the same time care has not been taken to separate completely the leaven which may remain in them. Hence the necessity of fining wines for their preservation, as well as their beauty. It will also be apparent, that if any fluid to be fermented, is of such quality, that the leaven predominates over the sugar, it will be necessary to stop the process by chemical means, to prevent the occurrence of the acetous stage, which would otherwise take place.

I have already stated, that both the malic and the tartarous acids take a share in the process of fermentation. Where the former naturally predominates, as in apples and pears, the produce is cider or perry ; where it abounds in the juice of the grape, it is supposed to lead to bad qualities in the wine. The practice of liming wine vats, and

that in use with sherry wines, seem to have been founded on some views of this nature.

It appears from the experiments of the Marquis de Bouillon, that tartar contributes to the formation of alcohol, and that it is partially decomposed during this process, a portion of it being converted into malic acid. But even sugar and tartar require the presence of vegetable extract, before they can be induced to ferment, although the addition of tartar materially increases the facility with which a compound of sugar and extract only is brought into fermentation. Hence we are enabled to explain the reason why moderately acid grapes run much more readily into fermentation than sweet ones.

From this view of the presence of tartar in the grape, and its utility, we may now deduce rules applicable to the art of domestic wine-making.

The juices of our fruits are known to be deficient in saccharine matter, and experience has long established the well known remedy,—that mixture of common sugar on which the whole art depends. But it has not generally entered into the views of makers of wine, to supply this other important defect, although the means are equally easy. The makers of *sweets* are indeed acquainted with it, although, from the defective nature of their process in general, it has not produced in their hands

the effects which might have been expected. Their principal error consists in the use of yeast and molasses,—articles, whose vicious nature is incorrigible; but in the experiments which I have directed to be made on this subject, ample reason has appeared to consider the addition of tartar to the juices of our fruits, as a valuable improvement in the art of making domestic wines. In the use of this ingredient, no very accurate limit seems necessary, since the wine of the grape may generally be considered as a saturated solution of tartar; and I may add, that by using crude tartar instead of the purified salt, we derive other advantages from the leaven contained in the lees attached to it.

From the preceding remarks, we shall be at no loss in understanding the true theory of this art. The formation of a liquor truly vinous, is the first object, and the adventitious circumstances of colour and flavour will be considered hereafter. It is almost superfluous to say, that the wine of the grape is superior to every other vinous liquor, and we have, in the foregoing remarks, a detail of the circumstances on which the formation of wine from that fruit depends. These are sugar, the extractive matter, and tartar. If now we compare our common fruits with the grape, we shall find, that, in common with it, they possess the extractive matter or natural leaven, but that they are deficient both in sugar and in tartar. Our first object, therefore, should be to assimilate them as nearly as

possible to the grape, by the addition of the requisite proportions of those two substances. The whole process is, therefore, from its commencement, artificial, and capable of considerable precision. It is only required so to proportion the adventitious ingredients to the natural juice, as to form a fluid resembling the juice of the grape. To the peculiarities of the several fruits employed, we must afterwards look for the flavour or other accidental properties which they may be capable of giving. It is necessary also to consider, that as the several fruits may differ in their quantity of leaven, as well as in their proportions of sugar and acid, some attention to their various compositions will be required, before any accurate rules of practice can be established. We can also see, that we are limited in the application of our own fruits, and that we cannot avail ourselves of all the use which we might derive from their natural sugar, nor in some cases from their leaven, lest we should introduce too large a portion of their malic acid ; that acid in which they are too apt to abound, and which I have already stated to be ill adapted to the formation of genuine wine. They who shall attempt to make wine from the juice of the currant or gooseberry alone, will feel practically the force of this statement. We also may see from these general principles, that we are not necessarily limited to the use of fruits ; since, being indebted to the fresh

vegetable for very little more than the extractive and fermenting matter, we are permitted to seek it, even among leaves and roots.

But to return to the agents engaged in fermentation ; water is one of these, and we have seen, that a certain degree of fluidity is essential to this process. If a mixed solution of sugar and leaven is concentrated to a certain degree, it refuses to undergo the act of fermentation, or enters into it with difficulty. For the same reasons, its progress is so slow, that the result is generally a sweet wine ; since the operator, accustomed to regulate his processes by time, rather than by the changes which the liquor experiences, is apt to conceive it finished before it is well established, and thus to suspend it, by the operations of decanting and clarifying, before the liquor has suffered all the changes of which, in due time, it is capable.

When the juice to be fermented, contains, on the contrary, too large a proportion of water, the fermentation is equally slow and difficult, but the produce is weak, and runs readily into the acétous stage. Thus, weak currant juice exposed to fermentation, is converted into vinegar, by a gradation so regular, that it can scarcely be said to form wine, during any part of its progress. In wine countries, these opposite evils are remedied, either by dilution or concentration. The artificial composition of the fluid used in the domestic manu-

facture, admits of more ready remedies, already sufficiently obvious from the preceding remarks.

Having examined the nature and re-actions of the ingredients to which the process of fermentation is owing, it is now proper to attend to the external circumstances which affect and regulate it, before any rational processes can be adopted for its conduct.

Temperature is one of the external circumstances which has the greatest share in influencing the act of fermentation, and that of 54° has been considered the most favourable. Some latitude is however to be allowed ; but in a temperature either very high or very low, this process does not go on at all. Attending to this circumstance, we are enabled to regulate the process when it does not proceed regularly, either by cooling the fluid to check its too rapid progress, or by warming it when it proceeds in too languid a manner. By this we can also explain a phenomenon of common occurrence in wine-making, a renewal of the fermentation which takes place in spring, after it has been partially or entirely suspended by the cold of winter. This is a subject worthy of attention, as some important practices in the art depend on it. Thus, if we are desirous of making a wine to imitate *Champagne*, it is necessary to watch for the period when the fermentation is re-excited by the arrival of spring. By bottling in this stage, we

insure a brisk wine, which, if bottled, either in the cold of winter, or after the second fermentation has been exhausted by the heats of summer, would be dead or still. This renewal of fermentation, or *fretting*, as it is sometimes called, is also a favourable time for the addition of flavouring matters, as they then give out their flavours and combine with the wine. It is at this time also, that spirits should be added to the wine, if it is ever allowable to make this addition. It is the only time at which alcohol can safely be added without destroying its vinosity, as it then enters into a kind of chemical combination with the wine.

It is necessary likewise to consider the effects which the *air* produces in fermentation, although its presence may rather be considered as favourable than essential. If the liquor is shut up in close vessels, it does not readily ferment, although it still slowly undergoes this process, and is at length converted into perfect wine. It is ascertained, that no air is absorbed during the vinous fermentation, although this happens in the acetous, but that the free and ready disengagement of the carbonic acid, is the principal circumstance in which fermentation in open vessels differs from that in close ones. One important fact, however, is established,—that the wine is stronger when the fermentation has been either partially or totally carried on in close vessels, and that the flavour is

also better preserved ; and it appears that a great part of the alcohol produced is dissipated by the carbonic acid, which holds it in solution, and which produces a well known effect, both on the organ of smell, and on the nervous system in general, when this disengagement is made in the stomach. It is not yet well explained, how the carbonic acid is disposed of when produced in close vessels. Many of the practices followed in making particular wines, depend on a consideration of these two modes of conducting the fermentation ; but it rarely happens that an exclusive fermentation in close vessels is used. This is generally reserved for the last and most tranquil stage. A consideration of the effects produced by these different methods, and of the product which we wish to obtain, will be necessary to guide us in our choice of either of these two processes, or of a certain admixture of both. If the wine is meant to be still, and if it is not desirable to husband the strength and flavour, the whole fermentation may be carried on openly. This will be the case with strong and sweet wines. If, on the contrary, a wine of the character of Champagne is intended, which must retain its briskness, flavour and strength, we must be guided in our practices by rules similar to those in use in that, and other districts of France, and adopt a partially close mode of fermenting. In all cases, it appears to

be a useful practice, even if the first fermentation is carried on in an open vat, to exclude the free access of air, by covering the vessel with boards and blankets. If the first fermentation is carried on in the vessel in which the liquor is meant to continue,—a case which can only occur when no solid matter is fermented with the fluid,—a slight covering will be sufficient. Whatever process has been adopted in the first instance, the bung may after a time be lightly put down, and ultimately tightened, a spill-hole being added, to give an opportunity of relieving the vessel from time to time, of the elastic fluid which might endanger its safety.

The *volume* or quantity of the fluid, is the last circumstance which requires notice, as influencing the act of fermentation. This process is more rapid and more perfect in large, than in small vessels, and is often entirely completed in the course of a few days in a large vat, while, in smaller vessels, it may require weeks or months for its perfection. This question, interesting to manufacturers of *sweets* on a large scale, is of little moment to domestic makers of wine, among whom the quantity made at any one operation is generally small. But it is not quite uninteresting even to them, as it explains some of the difficulties with which they have to contend, and serves to direct and guide their operations. The same materials, for example, will not

experience the same changes in equal times, if they are exposed to fermentation in the quantity of two or ten gallons ; and time will therefore be allowed by the operator, in a ratio the inverse of the bulk of the fluid on which he is operating. I may also remark, that if there be a flavour to preserve, it will more readily be secured when the fermentation is slow, and the mass of fluid small ; and that the sweeter and thicker juices, require to be treated on a larger scale than the thinner ones. It is easy to make lemon wines in a cask of two gallons, but it is a very difficult task to operate on so small a quantity of thick and sweet raisin wine. This is one of those general principles which, together with the quality of the liquid, the temperature, the proportion of leaven, and the other circumstances which I have inculcated, ought always to be present to the maker of wines, since it is only by conforming to the complicated actions of these various causes, that he can hope to secure certainty or uniformity of result.

I may pass lightly over the phenomena which occur during the process of fermentation, which, however important to a general view of this subject, are, from their minor share of practical interest, more easily dispensed with, than those details which are necessary to the unphilosophical practitioner.

The act of fermentation is marked by the extrication of air-bubbles, and by the agitation and

turbid appearance of the liquor. The turbid matter is shortly separated into two portions, which, in part, rise to the surface in scum, and, in part, subside in the form of lees. Both of these, as I have before shewn, have the power of continuing the act of fermentation; and it has also been shewn, that their separation, by decanting and clarifying, serves to check this process. For the same purpose, the cask is kept always filled to the bung-hole, so as to admit of the disengagement of the scum or yeast as fast as it is formed. The bulk of the liquor is increased during fermentation, partly in consequence of the heat excited, and partly from the extrication of the carbonic acid gas which is separated. It will be obvious, how the practices required in regulating the qualities of all wines, must be deduced from this general fact respecting the management of the yeast during its production, and that the manipulations must be different when either a sweet or brisk, or a still and dry, wine is desired. In the former two, the fermentation will be checked, by filling to the bung-hole; in the latter, the yeast will be allowed to subside.

The *carbonic acid* is not necessarily separated and disengaged from the wine, since the brisk wines of Champagne owe their sparkling quality to a portion of it which is retained by them, either in consequence of the period of bottling being duly chosen, or to a portion of leaven allowed to

remain in the bottled wine, and which has a tendency to renew the fermentation under confinement. This quality is sought after in many wines, and it is often, in the worst class of Champagne wines, the only valuable one which they possess. It is owing to the necessity of having a superfluous quantity of leaven for producing this effect, that a brisk wine is with difficulty made, unless a portion of unripe fruit enter into the composition. This is the case with the wines of Champagne, and equally so with the produce of our gooseberry, which has been conceived to resemble them.

I have already mentioned, that the carbonic acid of fermentation is supposed to contain alcohol, and thus, by fermenting in closed vessels, a great part of the spirit of the wine which would be dissipated, is retained and preserved.

Heat is also generated during fermentation, and to such a degree, as often to require tempering; but as this can only occur in manufactories on a large scale, I need not dwell on it.

The *colouring matter* of the fruit is extracted during this process, since the darkest grapes yield but a white wine, if their skins are not fermented in the liquor; and by attending to this fact, we can regulate the colouring of our wines at pleasure, if the fruit possesses this principle.

The last and most important effect of fermentation, is the *formation* of *alcohol* or *spirit*, and this de-

pende collectively on the proportion of sugar in the entire fluid, on the due proportion of the leaven to that sugar, and on the perfection of the fermentation. The whole of the sugar is seldom decomposed during the first process of fermentation; but a proportion is generally attached even to the wines considered dry, long after they are tunned or bottled. It is only by a slow continuation of the same actions in casks and bottles,—a process often requiring many years for its completion,—that the sugar entirely vanishes, and the liquor is found to consist of alcohol, combined with the other matters which join it to form wine. It is important to consider the effects produced on wine by a portion of undecomposed sugar remaining in it. As long as this exists, the acetic fermentation cannot take place, and it therefore offers a test of security against this result, in our ill made domestic wines. In the natural wines, the balance of principles appears to prevent this occurrence, even when all the sugar has disappeared, and thus Hock, Claret and Madeira, seem to be possessed of the power of endless duration.

All care will be unavailing, if the process of fermentation, and its application to practice, be not thoroughly understood; and I shall therefore deduce from the general doctrines laid down above, some further rules which have been cursorily passed over. If all the favourable circumstances already described are present, the act of

fermentation goes on without any assistance, by the action of natural causes. The circumstances which are capable of impeding these natural actions, exist either in the quality of the liquor, or in the temperature to which it is exposed. When the liquor is a natural *must*, like the juice of the grape, it rarely labours under any other defect than the want of saccharine matter,—a defect which the experience of wine countries has found the means of correcting by the addition of sugar of honey, or of *must* evaporated by boiling, until it has become a thick saccharine fluid. The same defect is also sometimes remedied, by partially drying the grapes, or by adding burnt gypsum, or plaster of Paris, to the *must*, so as to absorb the superfluous water. It is evident, that as the maker of domestic wines has always an artificial fluid on which to operate, he need never be subject to any inconvenience from this cause, as it is in his power at all times so to compound his *must*, as to render it answerable to the requisite conditions. The management of the fermentation, when it has actually commenced, must also be regulated by the views of the artist, respecting the wine which he wishes to obtain. If sweet, the proportion of the water as well as that of the leaven to the sugar, must be reduced in compounding the *must*, or his *working receipt* must be modified to this end; and the management of the fermentation will then be such, as to discharge

the yeast as fast as it is generated, by keeping the cask full to the bung-hole, and by a careful repetition of decanting and clarifying. If, on the contrary, the wine is to be dry and strong, the proportion of the leaven will be increased, and the yeast will be agitated with the liquor, by rolling and stirring, so as to protract the fermentation. If the wine is to be brisk, the proportion both of leaven and water will be increased, and the fermentation will not only be conducted in vessels partially closed, but the liquor will be bottled and secured, before the fermentation is finished. The management of the temperature is easily deduced from the general doctrines. When the fermentation languishes from defect of heat, it is necessary to introduce a stove into the apartment where the process is carried on, or, by heating a portion of the liquor, and mixing it with the mass, the temperature may be elevated to the most favourable point. Injurious changes, arising from variations of the external temperature, may be warded off, by a covering of straw or blankets. These attentions, trifling as they may appear, are by no means unimportant, since they are sufficient to cause the whole difference between good and bad wine. It is owing more to varieties in management, than to radical differences in the qualities of the grape, that the wines of different countries differ so widely from each other, and

that the wines of France, for example, possess a superiority so decided over all others.

The limited nature of this little essay, prevents me from entering on the chemical theory of Fermentation, a subject still very obscure; and I shall therefore proceed to consider the management of wines after fermentation, a subject of more practical interest.

Many popular practices in the after-treatment, and in the suspension of fermentation, are founded on positive precepts respecting the time which the process has occupied. But time is but one out of the many elements which should enter into this calculation; since it has already been seen, that it is modified by the varying quality of the fluid subjected to that process, by the temperature, by the mass, and by many circumstances which it would be superfluous to repeat. Other rules, which are apparently better founded, since they are deduced from the appearances after fermentation, may yet deceive us, if they are too implicitly followed, without a due regard to the ultimate intentions of the operator, respecting the quality of his wine. Neither the smell, taste, or colour of the fluid, nor the activity or cessation of the fermentation, are positive guides. As the prime object is to convert the sugar into spirit, it is evident that the fermentation must continue longer, if the

produce is to be a dry wine, and the reverse if a sweet one. If, on the contrary, it is the wish of the operator to preserve the flavour or *bouquet* of the wine, the period must be shortened. The case will be the same if a brisk wine is wanted, as the carbonic acid on which this property depends, would be irrecoverably dissipated, by an undue protraction of the fermenting process. As all wines are reducible to the four general divisions, of dry and strong, sweet, light and flavoured, or brisk ; it is plain, that a regard to this ultimate object, their quality must determine the mode of proceeding. If it is intended, for example, to make that kind of dry wine which is made in this country from raisins and sugar, the same practices will be necessary which are followed in the countries where wines are made from the grape for distillation. In this case, the wine is suffered to remain in the vat for three, four or more days, until it ceases to have a saccharine taste, and till the whole of the sugar is converted into spirit. If it is intended to make a strong and sweet wine, the fermentation must be discouraged, by speedily removing it from the vat to the cask, and by the further use of processes hereafter to be described, which suspend and ultimately destroy the fermenting process. If it is desired to produce a light and flavoured wine, like those of Burgundy, for example, the practices should resemble those followed in that country. There, the *must*

is allowed to remain but a few hours in the vat, the time varying according to the quality of the *must*, the temperature, and other accompanying circumstances. The period is, *cæteris paribus*, always shortened, when flavour or perfume is expected from the wine; a precaution, however, which the maker of domestic wines may dispense with, as the little flavour he has to expect from the fruits of his own growth, is generally better avoided. Further, if it is proposed to make wines brisk, and resembling those of Champagne, the juice must remain in the vat but a few hours; and indeed when small quantities only are operated on, it is often prudent to conduct the whole process in the cask, even from the commencement.

I cannot conclude these general directions, without inculcating the necessity of cleanliness in the use, and care in the selection of the casks, since results otherwise promising, are often destroyed by this minor sort of negligence.

In removing the wine from the vat to the cask, it is necessary to get rid of all the insoluble and superfluous matter which it may contain. This removal, is in fact the first stage of decanting,—an operation of which the careful conduct is of prime importance in this manufacture. By tapping the vat at a due distance above the lee, and by stopping the flowing liquor before the scum has descended too low, this separation is in general

easily effected. In some cases, straining may be required ; but in all, the scum should be carefully removed, as it is from exposure apt to acquire either a musty taste, or acid property, easily communicated to the liquor. In the wine countries, the solid matter is exposed to the wine press. Here it would not be an object worthy of the labour required.

The wine thus far advanced, still undergoes a fermentation in the casks, more languid, yet necessary to its completion. If this process be suffered to go on indefinitely in those wines of which the saccharine matter has been entirely decomposed, it will proceed to the acetous stage, and vinegar instead of wine will be the result ; the natural tendency of fermentation being a progress from the vinous to the acetous stage, which, if not counteracted by circumstances in the wine itself, must be prevented by artificial expedients. The natural circumstances which prevent this change, consist in that state of proportion between the leaven and sugar, which allows part of this last to remain undecomposed after the process is completed, or a balance of principles so nice, as to terminate in a perfect neutralization of the two elements which conspired to produce it. This accuracy is perhaps seldom obtained, since the palate is unable to detect the last portion of sugar, masked as it is by the predominant taste of the wine, on the qualities of which it nevertheless produces an

advantageous effect. Knowing that the acetous process cannot take place while sugar remains unchanged in the fluid, we can regulate our conduct in the use of the artificial means of checking fermentation above alluded to, since any anxiety on this head is unnecessary while the wine continues sweet. We can also see from the same consideration, how the addition of sugar to a wine whose durability is suspected, may prevent the acetous process from taking place, although, when this process is once established, it would be, according to circumstances, either unavailing, or the cause of a speedier conversion into vinegar.

I must now describe the artificial means by which fermentation may be checked or stopped, in those cases where a natural termination would not occur. Those most generally used, are racking and fining, of which the object and effects must already be intelligible to those who have read the preceding remarks. Turbid wine is in an unfinished state, as well as in a precarious one, and its brightness and purity is not merely an ornament, but a property necessary to its permanence. It is from being left in this state, that wine frequently becomes *pricked*, this disease being the first stage of the acetous fermentation, but one which may also originate in other causes already explained. But although racking and fining may disengage the wine from all precipitated leaven, if

will not separate that which is held in solution, and of which the tendency is equally to destroy the wine at some distant period. For this purpose, chemical means are required, and the process in common use, is known by the name of *sulphuring*. Many unnecessary and complicated methods are resorted to for this end; the most simple is equally effectual, and consists in filling the empty cask with the vapour of sulphur, from burning matches placed in the bung-hole. The wine is then introduced into the cask, and if this first operation is found insufficient, it may be repeated as often as is necessary. When the *leaven* is so abundant, that a very large quantity of sulphureous acid is required, as in many of the wines of Bourdeaux, a portion of wine, impregnated with the gas, by a process similar to that of the silk-bleachers, is used for mixing with the wine in the cask. The sulphite of potash, offers itself as a convenient substitute for this operation; and in the quantity of a drachm or two, it is sufficient in general for a large cask of liquor. Other chemical agents, capable of accomplishing this end, might be enumerated; but the operation of the whole is similar, and consists in precipitating, and rendering insoluble the leaven which was contained in the wine. It is obvious, that this process must be followed by that of racking and fining. The substances used for fining, are most commonly isinglass, or the white of eggs, and the mode of

applying them is universally known. Sand, gypsum, starch, rice, milk, blood, and the shavings of beechwood, have been found to answer the same purpose.

In the general practice of making wine from grapes, many expedients are in use, to remedy particular defects of colour, sweetness, flavour, sharpness or dullness. As few of these are applicable to wines of domestic manufacture, I shall pass them over slightly. The causes and remedies of excessive sweetness, must already be obvious from what has been said. The causes of offensive sharpness, are either the excessive fermentation of a weak and watry *must*, or an undue portion of malic acid. In the former case, the wine is tending to vinegar, and although the evil may be palliated, it can scarcely be remedied, nor is it perhaps, in the case of our domestic wines, worth the remedy. The use of lead, chalk, and other expedients, must be left to manufacturers. The mode of prevention, is more worthy of our attention, and it is obviously that of using a better *must*, or attending more carefully to the fermentation. That sharpness which arises from excess of malic acid, is well exemplified in hard cider. It is not a fit object of remedy, but may be prevented by a better choice of materials, or by the expedients alluded to in the beginning of this paper.

A disagreeable quality opposed to the former, is flatness, or a mawkish flat taste, which, though

sensible to the acuter palates of those who are habituated to good wine, is scarcely perceived by those who are accustomed to the strong dull wines, so generally used in England. The light and quick flavour, so preceptible in the wines of France, disappears under the treatment by which the more fiery wines of Spain and Portugal, are made marketable in this country. At times, flatness may arise from age, or from the complete annihilation of the fermenting process ; but the most common cause is the admixture of brandy or spirit. This addition, when used in excess, is not only injurious to the liquor, but to the constitution, as it introduces an additional quantity of ardent spirits, into a beverage already perhaps too strong. Its use is also in some measure founded on a mistaken principle, as it is resorted to, at least in this country, among the makers of domestic wines, for the imaginary purpose of checking fermentation, and preventing the occurrence of the acetous state. It has been shown by recent trials, that alcohol does not check the acetous process, unless added in a much greater quantity, than it is ever used for wines ; and I have already pointed out the true principles on which the tendency to vinegar may be prevented. An idle notion is prevalent among makers of domestic wines, that they are deficient in durability. The unfounded nature of this belief, must appear from every thing which has been stated respecting the true theory of wine ; and I

may here add, that the durability of these wines, is in fact shortened by the admixture of brandy, since it ultimately decomposes them, driving off their carbonic acid, destroying their brisk and sprightly taste, and rendering them vapid and flat, while at the same time, their salubrity is diminished, and their price increased.

If, notwithstanding this view, makers of wine are still determined to have recourse to the practice of adding spirit; I will now point out the least injurious manner in which it may be effected. It may be added to the liquor before fermentation,—a method in use in the manufacture of sherry. It may also be added, during the subsequent renewals of the fermentation, which have a sort of periodical recurrence in the cask; the operation being founded on the practice known to wine-coopers, by the term *fretting in*. When for any purpose it is found convenient to mix two varieties of wine, that time of spring is selected, when a slight fermentation is renewed, or this process is brought on by rolling or heating. A perfect union of the wines mixed at this period then takes place, a slight fermentation being induced, which serves to unite the whole into one homogeneous fluid. It is under similar circumstances, that brandy may be added, and it then enters into a combination with the wine, more nearly resembling that natural union in which alcohol exists in this fluid; while

at the same time it produces less injury, either to the flavour of the liquor, or to the health of the consumer.

The sketch which I have now given of the general principles of wine-making, may possibly suffice for the purpose of practice, and enable the practitioner to guide himself by rules, both more correct and more generally applicable, than the positive ones on which he has hitherto proceeded. I shall now proceed to a cursory examination of the several practices in use in our domestic manufacture. The receipt books abound with details, which it is unnecessary for me to examine, as it would be a waste of time to comment on manipulations, which have been guided by no principles, of which a great number is manifestly absurd, and of which many others appear incapable of giving results at all resembling wine. I shall content myself with noticing the most prominent errors, and with pointing out those general practices in which the most rational receipts can be made to agree.

When we read in many of those books of receipts, directions for sulphuring the casks before fermentation; we must be convinced, that such directions have arisen from an utter confusion of ideas on the subject. The same remark may be made on another rule, of which the object is equally misapprehended; the mixing of white of egg with the fluid about

to be subjected to fermentation. The proportions of sugar seem to have been allotted with equal want of consideration ; and it seldom appears to have entered into the minds of the inventors, that the strength of the wine was to depend on this ingredient. The proportions of the fruits to the total compound, seem to have been dictated by similar caprices ; their natural properties, whether of sugar, acid or flavour, not having been considered in the views of the artist.

Those ingredients which are added for the avowed purposes of flavour, have been managed with similar want of judgment, and they have indeed often been supposed capable of communicating the strength, or vinous quality, to the liquor. Instead of being introduced at the decline of the fermentation, they have been exposed to all its effects ; in consequence of which, their flavour has often been volatilized or destroyed. This is the case with cowslip wine, where an enormous quantity of flowers is used, to obtain an effect which might be procured with a much smaller allowance. Such also is the practice with raspberries,—a practice worth noticing, since it affords an opportunity of stating the more correct and useful mode of proceeding. If an attempt is made to form wine from raspberries and sugar, a liquor will be produced with little or no flavour of the fruit ; but a small quantity of syrup or juice of raspberries added at the decline of the fermentation,

or a little fresh fruit suspended in the cask at the same period, will be sufficient to communicate a taste, more likely to prove excessive than defective.

But the most striking defects of the common proceedings are visible in the vacillation and uncertainty, with which both the fermentation and the subsequent processes are conducted. By using the yeast of beer,—a practice founded on ignorance of the nature and causes of fermentation,—a false and bad flavour is introduced, which is often sufficient to render the produce tainted and even nauseous. By want of attention to the process itself, and the circumstances by which it is affected, the artist is unable to advance or retard it, to alter or amend it; while, guided solely by rules founded on fixed periods, inattentive to his subject or its concomitancy, and undecided respecting the future character of his wine; it is not surprising if he meets with perpetual disappointment, producing still wine when he wished for brisk, or sweet when he intended to form dry. The same want of principles prevent him from taking advantage of the practices of sulphuring, racking and bottling, as will be obvious to those who shall compare the practices in daily use, with the more correct ones which have been laid down.

I must now proceed to give a view of the methods in common use, as far as they offer differences worthy of notice, confining myself to those

varieties of domestic wines, which are either in themselves good, or capable, under proper management, of being rendered so. I shall take no notice of the projects to make wines from esculent roots, as I believe that they are misplaced ; but limit myself to fruits, from different kinds of which, the several wines take their names. I shall also omit the grape at present, because, considering it as almost exclusively worthy of attention, I wish to treat of it in a separate paragraph.

The fruits chiefly in use are the quince, cherry, strawberry, sloe, elder-berry, damson, mulberry, black or bramble berry, raspberry, orange, lemon, gooseberry, and the three varieties of currant. Dried raisins, although not ranking among our fruits, are extensively used, and require also to be noticed.

A wantonness of experiment seems to have, in some measure, led to this great and superfluous number of articles as the nominal bases of wines, although the practices have also been in a great degree, founded on false views of the real nature and objects of this manufacture. It is evident, on the principles already laid down, that when no peculiar and agreeable flavour follows the adoption of any individual fruit, it can have no legitimate claim for use, beyond that which is founded on its several proportions of sugar, leaven, acid, colour or astringency. As the two last of these can be communicated with the greatest certainty

by adventitious ingredients, it is bad policy to have recourse to weak expedients for the same, and particularly, if, for the sake of these minor objects, we must sacrifice others of greater importance.

Since also the sugar is, confessedly, and in all cases, an adventitious ingredient, capable of being proportioned with the greatest nicety, completely in our power, and of a moderate price, it is unnecessary to consider that ingredient in fruits, as the one which is to guide our choice. It is to the due admixture of acid, and of leaven (the fermenting principle), that we are chiefly to look for the causes which are to determine us in our selection. If a good flavour can be obtained from any fruit of our own growth, we have then the whole data which should rule our determinations. The object of price, is a consideration which will naturally be added to these more important ones.

The Quince appears to have usurped a place in the foregoing list, to which it properly has no title. Its similarity in principles to the apple and pear, is sufficient to assure us, that its produce can only be a species of cider, characterised, according to circumstances, by the astringency and flavour which distinguish it from these two fruits. Its price and rarity also increase the objections to its use.

Vinous liquors, of no very particular character, may be made from the several varieties of Cherry ; but the operator should be cautioned against the the common practice of pressing the kernels in

quantity, as, however agreeable a slight flavour of the bitter may be, a taste amounting to bitterness, is always unassimilating and injurious to the wine.

From the Strawberry, wines of agreeable quality, both dry and sweet may be produced ; but the peculiar flavour of the fruit is generally dissipated in the process. The cautions which I have given respecting flavour, will suffice to point out in what way that is most likely to be obtained.

I make the same remark on the Raspberry, with this additional hint, that as very little in point of flavour or produce is gained by the use of these fruits, which are in most places of a high price, it behoves the operator to balance the advantages against the disadvantages, before he enters on the undertaking. A simple infusion of this fruit, as before noticed, in any flavourless currant wine, will, with greater cheapness and certainty, produce the desired taste.

Having no experience in the Brambleberry or Mulberry, I am unable to say, whether any flavour can be communicated by their use. The cheapness of the former is a recommendation ; and there is no doubt that they both contain the substances, leaven and acid, most essential for this purpose. They also afford what so few fruits do to the same degree, the colouring principle. In managing them, so as to derive the greatest advantages from their colour, it is necessary, that the fermentation be allowed to go on with the skins, until the co-

lour is extracted, which will also be accompanied by the slight degree of astringency, which, at a certain period of ripeness, accompanies both these fruits.

The Sloe and Damson are so associated in quantities, that nearly the same results are produced from both,—a bitterish and astringent liquor, capable of being converted into rough wine of a good character, care being taken duly to proportion the quantity of fruit to the sugar, or to modify that liquor by the addition of other fruits of less decided properties. This is a case, in which it is necessary to protract the fermentation, so as to make a dry wine, as the peculiar astringency of these fruits, forms a very discordant association with sweet wines. By a due admixture of currants or elder-berries, with sloes or damsons, and with proper care, wines not much unlike the inferior kinds of Port are often produced. Since receipts are in the hands of every one, I need not detail the proportions, which ought, in fact, to vary, both according to the ripeness of the different fruits, and the particular views of the artist.

In naming the Elder-berry, I have mentioned a fruit whose cheapness and abundance have long recommended it to notice ; and from which, with attention, excellent red wine can really be made. It seems to possess in great perfection, that portion of the extractive principle, which is requir-

ed to produce a free and full fermentation ; and its admirable colour, communicates to the wine a tint as rich as can be desired. It appears to be deficient in acid ; and its produce is consequently much improved, by the addition of tartar as an ingredient in the artificial *must*. Its natural sugar is so small in quantity, that it requires an ample addition of this fundamental ingredient. If it has no good flavour, it is at least free of any bad one,—a virtue which does not appertain to many of the fruits of current application in wine-making.

In apportioning the two several ingredients of tartar and sugar, the following rules may be of use.

Considerable differences in the dose of tartar may be allowed without producing any correspondent changes in the result, and the proportion of this ingredient has consequently been made to vary from one to four, and even six *per cent*. The causes of this admissible laxity will appear, when it is considered that the greater part of the tartar is deposited in the lees. I may also remark, that from two to four *per cent*. will be found a sufficient dose, and that in proportion to the greater or less sweetness of the fruit, the sweetest requiring the largest quantity of tartar, and *vice versa*. The dose of tartar ought also to vary in proportion to the added sugar, increasing as this increases. Although pure tartar, or cream of tartar, may answer the intended purpose, the crude salt

is to be preferred, because it already contains a portion of yeast conducive to the more perfect fermentation of the artificial *must*.

In proportioning the sugar, the following general rule may also be taken as a guide. Two pounds of sugar, added to a gallon of a compound, containing all the other ingredients requisite to a perfect fermentation, produce a liquor equal in strength to the lightest class of Bourdeaux white-wines. Three pounds produce one equal in strength to the wine known by the name of White Hermitage: and from four, if fermented till dry, a wine resembling in strength the stronger Sicilian wines, that of Marsala, for example, or the Cape Madeira, is produced, supposing these wines to be free of brandy. Where a fruit already contains sugar, it is obvious that the quantity of added sugar must be diminished in proportion to that which the natural juice may be estimated to contain, if we are desirous of accurate results. If in any case wine is to be left sweet, it is clear that this general rule cannot be applied, since sweetness and strength are, in the same wine, and from the same quantities of sugar, incompatible. The rules thus laid down, render any formal detail of proportions unnecessary, since they are readily deduced from the general view; and the circumstances which ought to regulate the fermentation and after-management, have already been so fully investigated in the first part of this essay, that it would be superfluous to repeat them.

But, while on the subject of the juicy fruits, I may as well notice a part of the current practice which appears ill founded, and often attended with bad consequences. This is the large proportion of water, and consequently small proportion of fruit, which is generally used, an usage apparently originating in a misplaced economy. If we attend to the common practice of making wine from grapes, that which ought to be the model for all our imitative operations, we shall see that no water is used, but that the whole fluid is composed of the juice of the fruit itself. If we now attend to the current practice, as recommended in our own domestic receipts, we shall find that the juice of the fruit rarely forms more than one-fourth of the whole liquor, and often much less, the proportion of fruit being seldom more than four pounds, including the solid matter it may contain, to eight pounds of water, and three or four pounds of sugar; and this proportion is fixed with no regard to the ripeness of the fruit, a circumstance of considerable importance. The consequences resulting from this sparing use of the fruit are highly injurious. It is plain, that the artificial *must*, thus compounded of water, sugar and juice, must contain a much less quantity of the vegetable extractive matter, and of the native acid, than that which I have formerly shewn to be absolutely essential to a perfect and

efficient fermentation. To put this case in a stronger light, let this proportion of juice be still further gradually diminished, and the *must* will soon consist of little else than sugar and water, a compound incapable of forming wine. Let it, on the contrary, be increased, and a vigorous and perfect fermentation, with a produce perfectly vinous, will be the result.

If green fruit is used, in which little or nothing exists but acid and extract, of which the former is in this case always in much greater proportion, bulk for bulk, than in ripe fruits, the acid would be too predominant were the juice of the fruit used in undue quantity. There dilution is absolutely necessary, and of this practice I shall take occasion to point out examples hereafter. But if the fruit be ripe, the acid is diminished in quantity, and cannot therefore bear to be still further diminished by excessive dilution. It will accordingly be found, as I shall again have cause to shew, that a much more perfect wine is produced by diminishing the water, or increasing the proportion of fruit.

As the *orange* and *lemon*, although not native fruits, are familiar to us, and scarcely differ in their chemical composition, I may safely consider them in one view. So little difference exists between the citric acid which is found in these fruits, and the tartarous which characterizes the grape, that it is natural to expect their produce to

be of a good quality. They are, however, deficient in extractive matter or leaven, and for this reason are incapable of being converted into wine, even with the aid of sugar, unless yeast or some other leaven be added. As it is impossible to add the yeast of beer in sufficient quantity for the perfect fermentation of the fluid, without spoiling the flavour, these wines are generally imperfect and sweet. They are likewise almost always corrupted in their flavour by the infusion of the peel, giving a taste, which, however grateful abstractedly, does by no means coalesce with the taste of wine. It would tend to the improvement of these wines, if the peel were to be omitted, and if any vegetable matter could be added capable of inducing the complete fermentation, without communicating a bad flavour. I have attempted it by means of gum, and with partial success. The principles I have already pointed out, will lead experimentalists to the search of proper substitutes for the natural leaven. It is not unlikely that they would be found in wheat; either in the flour or gluten.

The *gooseberry* is one of the fruits most commonly used, and is in particular well known as an ingredient in brisk wines, which are made to resemble, in appearance at least, the wines of Champagne. For this purpose, it is used in an unripe state. It is well known in the wine countries that, independently of those causes of briskness in wines

which consist in the management formerly described, this property always results from the use of unripe fruit, and is readily produced by mixing unripe grapes with the ripe ones. The case is the same with the gooseberry. The fault of this wine, however, if it be considered as an imitation of Champagne, is a bad flavour, which is almost invariably communicated by the fruit, and that in proportion to its ripeness. To avoid this evil, so generally injurious to the brisk gooseberry wines, the fruit can scarcely be taken in a state too crude, as at this period the flavouring substance has not been developed. At the same time the expressed juice alone should be used, care being taken to exclude the skins from the fermentation, as being the part in which the flavour principally resides. With these precautions, the noxious flavour may generally be prevented. It is true, that the produce is then without flavour, or nearly so, but this is by much the most tolerable fault in domestic wines, whose leading defect is almost invariably a disagreeable taste. Various proportions of fruit and sugar are used by different persons; but the most common consist of three pounds sugar and four of fruit, to eight pounds of water. Here the proportion of fruit is too small compared to that of the sugar, and the fermentation is consequently in general so imperfect, as to leave the wine disagreeably sweet. At the same time, the proportion of sugar is such, as to render the wine stronger than

the strongest wines of Champagne. If, therefore, this wine is to be amended in composition, it is either by reducing the sugar, if we are contented with a weaker wine, or by increasing the fruit, if we are desirous of retaining the greater strength. In managing the fermentation to a constant and successful result, the rules laid down as practised for Champagne wine are strictly applicable in the present case ; and with these precautions and practices carefully attended to, the produce of the gooseberry will be invariably successful. I may also add, that it is perfectly durable ; as much so as Champagne wines of corresponding quality, provided equal care be taken in the bottling, the cellarage, and other management ; all of them, circumstances in which our domestic fabricators are too apt to fail, thinking that when they have mixed together a portion of sugar and fruit, their labour is finished, and that the rest may be trusted to chance. They should consider, on the contrary, that it has but then commenced.

From the gooseberry in a ripe state, wines may also be made, for which no rules are required, as they are precisely conformable to those before laid down. But the produce of the ripe fruit is commonly ill flavoured, and, whether sweet or dry, is scarcely to be rendered palatable, unless perhaps, by a most careful exclusion of the husks.

The three varieties of the *currant*, are perhaps even better known, and more in use as ingredients

in wine-making than the gooseberry ; and as the produce of each is attended with some difference, I shall notice them separately. Both from the *white* and *red* sort, wines are made, which differ principally in colour, but also vary slightly in flavour, though the flavour of neither is very characteristic. I have ascertained by repeated trials, that a principal defect in these wines, as commonly fabricated, arises from the sparing proportion in which the fruit is used, which otherwise contains a sufficient quantity of natural acid, as well as extractive matter, to ensure a perfect fermentation, if properly managed. Partly from this cause, as well as from the imperfect management of the fermentation, these wines are usually made sweet. They are also, not uncommonly, nauseous, as well from the combination of a natural bad flavour with this mawkish sweetness, as from the other improprieties of management before noticed. By increasing the quantity of fruit, (which is generally proportioned like that for gooseberry wine,) and by avoiding the use of the husks, the flavour is materially improved, and the quality of the wine further ameliorated, the fabricator at the same time acquiring the power of making his wine sweet or dry ; whereas, according to the present mode, he is generally unable to produce the latter variety. The natural tendency of this fruit is to form a wine analogous to the lighter white wines of the grape, and it is a rational object to

follow the tendency which is pointed out by the nature of the fruit. I have also reason to think that much advantage would result from the use of tartar in this case, by which, among other defects, the ammoniacal taste so common in this wine seems to be prevented. The proportion of tartar need not be specified, as it has been mentioned before, and that of sugar is to be regulated by the principles already laid down. With careful management, wines are thus produced from currants not easily to be distinguished from the Colares of Portugal, which, although not in the first class of wines, is certainly superior to most of our domestic manufactures. A considerable improvement may be made in the fabric of all those wines produced from fruits of which the flavour is either bad, or which possess no flavour at all; and this is by boiling the fruit previously to fermentation,—a practice which I have caused to be adopted in currant wines with decided success. From this treatment many tasteless fruits acquire a flavour, as is well known, and many bad flavours are converted into agreeable ones. In no case, perhaps, is this more remarkable, than in the *black currant*, which, harsh, and comparatively insipid in its natural state, acquires by boiling a powerful, and to most persons a highly agreeable flavour.

In making wine from this variety of currant, the effects of this process are very remarkable; the

produce of the raw fruit being scarcely distinguished by any particular property from the herd of domestic wines, while that of the boiled fruit may with careful management be brought to resemble some of the best of the sweet Cape wines. In the white and red currant, the same precaution has been attended with results equally successful, though not marked by a contrast so decided. The same varieties of proportion are admissible in this case, as in the others lately mentioned, and I need not therefore detail receipts which are to be found in the hands of every one. To what extent the practice of boiling may be tried with advantage, I do not know ; but I may venture to point it out as an improvement worthy of further investigation.

Although the dried *raisin* cannot be considered as a domestic fruit, yet as, like the orange and lemon, it is largely used in the manufacture of domestic wines, I may here take notice of it. The history of the art of wine-making, in the countries where the vine is an object of common cultivation, has already shown, that the grape is in many places used for this purpose in a state, if not actually that of raisins, yet approaching towards it. Thus, the wines of Cyprus and Tokay, among many others, are produced from grapes which have undergone a partial desiccation. Analogy, therefore, would lead us to expect, that wines of good quality, might, in this country, also be pro-

duced, by using the dried grapes for that purpose, as they are imported in the state of raisins. Yet the success which has followed the innumerable attempts to make raisin wine, has by no means justified that expectation, although the expensive scale on which the manufacture has been, and is still carried on by the makers of *sweets*, should long ere this have brought it to perfection. It is not apparent to what causes this failure is owing, nor is it possible, without repeated and expensive experiments, to investigate the process in such a way, as to lay the foundation of a more successful practice. But an examination of the processes in common use, may perhaps suggest some hints conducive to a more rational and improved mode of proceeding.

In manufacturing this wine on the large scale, whether for the purpose of open sale as *sweets*, or for the fraudulent imitation and adulteration of foreign wines, a quantity of raisins varying from two as far as seven pounds to the gallon of water is used, together with a proportion of common clayed sugar or molasses, reaching from half a pound to three or four pounds. In many cases from four to six pounds of crude tartar per cwt. is added. Yeast is not in general employed to assist the fermentation, nor should it ever be used, for the reasons already assigned. It is asserted, that the product of this process is a pure and flavourless vinous fluid, capable of receiving any

flavour which may be required, and thus, of imitating many wines of foreign growth. Whatever the case may be when such fluids are used for the fraudulent purposes above-mentioned, the wines themselves, which are common in the market, and which are confessedly made in this way, are almost always nauseous, whether sweet or dry, and however they may be called by the various names of Lunel, Teneriffe, Sherry, or Canary, they have all the same disagreeable and overpowering flavour. It is probable, that a great part of this peculiarity is owing to the quality of the sugar employed ; but it is also to be suspected, that the complete drying of the grape developes in that fruit, some obnoxious taste which is communicated to the produce. I cannot pretend to throw any more particular light on the subject ; but should recommend to those who are inclined to make trial of raisins, a nice attention to all the circumstances in the mode of fermentation and management, which have already been detailed. If these fail to produce the desired effect of purity in the wine, we shall then be entitled to consider the manufacture of raisin wine as incapable of further improvement.

I have thus given such a brief general view of the several varieties of wines which may be made in this country, as will be sufficient to render more intelligible, the principles and practices on

which they are founded, without which, all attempts must either be futile, or must at least be regulated by chance, giving results, which will seldom obey the previous intentions of the manufacturer. The reader, who shall be at the pains of comparing what has now been said on our domestic fruits, with the more detailed theoretical and practical views laid down in the first part of this essay, will easily form for himself a correct set of rules of practice. It is in vain to say, that correct rules can be laid down in an abstract form, and capable of easy application, or that the practice may be rendered perfect, independently of the theory. Circumstances of a most evanescent nature, and, although important, often unheeded, necessarily interfere with all positive rules, and new cases are continually occurring, for which no previous rules can be given. He who is acquainted with the theory of the art, is always in possession of that light which will alone guide him through the intricacy of new cases, and of unexpected results. With the small apparatus of a theory, he has it in his power to do that without difficulty, and without labour, which he, who is destitute of theory, can seldom execute, even with the cumbrous and generally unintelligible apparatus of a set of fixed canons.

In making wines, as it is to be supposed that the fabricator has previously adopted some general views regarding the species of wine he proposes

to make, and does not intend to trust the result to chance, he should consider of what kind he wishes his wine to be, or which of the several modifications of foreign wines he means it to resemble. By these considerations, he must be guided in his practice ; and to assist his views, I will briefly enumerate the several varieties which it is in his power to imitate, in their general and fundamental qualities.

The first and simple class, are the *sweet wines*, of which the fermentation is incomplete. This incompleteness may arise from two sources, either the disproportion of sugar in the *must*, or the artificial means adopted for suspending the fermentation, and which have been already described. It is to this class that our native wines bear the greatest resemblance ; a resemblance indeed so general, that few makers of this article appear to possess sufficient knowledge of the art, to enable themselves to steer clear of that which may be fairly called the radical defect of domestic wines. But a consideration of the causes of sweetness in wines, already amply laid down, and of the modes in which it may be avoided ; will, I trust, enable the manufacturer to choose, whether his wine shall be sweet or not,—a choice, which in the present mode of management, is rarely left to him.

The next leading description of wines, is that to which, either in a state of sweetness, or comparative dryness, is super-added the effervescence

On uncorking, which produces *briskness* or *sparkling*. The causes of this phenomenon, and the mode of ensuring, preserving and regulating it, have been also fully detailed ; and it has been seen how it is compatible, either with a very considerable sweetness, or with a limited degree of the same property. As this modification is also esteemed among the made wines, it is desirable that an accurate knowledge of the method of producing it should be attained, since it is frequently missed, in consequence of negligence or ignorance in the conduct of the process. It is from gooseberries almost solely, that this variety has in this country been made ; but it is by no means limited to that fruit, since, with due attention to the period of maturity, and with careful management, it may be equally well made from any other fruit. I must not, however, quit this subject, without cautioning the operator against a bad expedient, to which recourse has been had for producing the effect of sparkling. It is the introduction of a small portion of carbonate of potash or soda, into the bottle immediately before corking it. The consequence of this, is doubtless, a disengagement of gas at the moment of pouring out. But the gas speedily flies off, almost before the wine can be drunk, since it exists but in a loose state of combination, and in but small quantity. Nor does it communicate to the palate, that agreeable and lively sensation, which follows from the disengage-

ment of that carbonic gas, which is in a real state of combination with the wine. Moreover, the neutral salt formed by the alkali, with the natural acid of the wine, is always sensible to the taste ; while at the same time the native acid of the wine, so essential to the composition of this fluid, is destroyed ; not to mention the danger of this acid taste being replaced by an alkaline one, from an over-dose of that ingredient.

The third variety of wine, is that, of which Hock, Grave and Rhenish, may be taken as examples. In these, the saccharine principle is entirely overcome by a complete fermentation, while their after-change is prevented by a careful application of those processes laid down for the preservation of the wines of this class. Makers of domestic wines have rarely succeeded in imitating these wines. The reasons are obviously two-fold, the great disproportion of the sugar to the subsequent fermentation in the first instance, and that want of the after-management, the neglect of which soon consigns these wines to the vinegar cask, if chance should even at first have produced success. I may venture to point out the imitation of these wines, from my own experience, not only as readily attainable, but as among the very best of those which can be made from domestic fruits. It is evident from what has been already said, that the relative proportions of the fruit and sugar in most common use, must be materially altered, and that

the fermentation must be conducted in a much more perfect manner, before we can hope to produce wines of this character. It is equally evident, that the processes of racking, sulphuring and fining, must be practised with great assiduity, to preserve these wines after we have succeeded in making them.

The last class of wines, are those which are both dry in their quality, and strong in their nature. Such are Madeira, Sherry, and the stronger wines. The theory of these, is equally apparent ; and it is certain, that with due attention to the the fermentation, wines of this strength and quality may be made without the addition of brandy. Yet the operator has it in his power by means of this ingredient, under the restrictions already laid down, to produce wines of any required degree of strength ; and I trust, that with the light which I have thus endeavoured to derive from the legitimate processes of wine-making, I have established a beacon to guide him through the trackless route of his hitherto conjectural art.

British Grape Wine.

I have chosen to throw into a separate section of this essay, the remarks which I had to offer on the art of making wine from *Grapes* of British growth, on account of the greater importance of this part of the subject, and also on account of the neglect which seems to have attended that branch of domestic wine-making. I hope to make it appear that wines, not to be distinguished from those of foreign growth, can, in this country, be made from *Grapes*, and at a moderate expence; and that the success of this process is not at all affected by the uncertainty which attends the ripening of the grape in our climate. It is not too strong an expression to say, that the use of this fruit is calculated to supersede that of all others, and that it is, in fact, almost the only species of domestic wine which is worthy of serious attention.

The essays of Mr Pegge in the *Archæologia*, with the subsequent controversies which originated in the opposition of Mr Daines Barrington, have established beyond doubt the fact, that vine-

yards were cultivated in the monasteries of Britain, for the purpose of making wine. It appears, however, by the records of Ely, that the grapes did not ripen every year, but that the vineyards, as might be expected in this climate, were subject to occasional failures. We have therefore no reason to conclude, from the establishment of this fact, that our climate has undergone any material and steady alteration,—a supposition which is often hazarded by discontented horticulturists without sufficient grounds, and apparently from no other cause, than that ill humour which delights, as it has at all times delighted, in praising the past at the expence of the present.

The physical history of Europe, indeed, shews, that its climate has, for many centuries, been in a state of amelioration. Whether this amelioration may not now have attained its *maximum*, is another consideration. If it has so done, it is certainly within a period comparatively very recent. As far as we are capable of judging, no material variation in the success of our horticultural speculations has occurred for the worse, provided we choose periods of sufficient length to admit of an average result. Occasional seasons of peculiar severity, or unusual irregularity, can afford no ground for judgment. The suppression of the monasteries, the great and splendid changes which our whole system of agriculture has undergone

since those days, the increase of trade, the more economical division and application of capital to objects of commerce, and to those of domestic manufacture, the multiplied demands which wealth and prosperity have made on the consumption of wine, and the increased discrimination and taste which this has produced, have combined together to change materially both the objects of commerce and cultivation, and have jointly operated in producing the decay of this art, if (as is by no means proved,) it was ever actually practised to any great extent. But this question does not concern our present purpose. It is sufficient to prove, what in fact there is no reason whatever to doubt, that the grape, as it is or may be cultivated in England, is capable of making wine; whether with advantage, considered in an agricultural view, and with what advantage, must depend on other considerations into which I need not now enter. However diminished this practice is in modern times, it is by no means extinct. The cottagers in Sussex are in the habit of making wine almost annually from the produce of vines trained on the walls of their houses. Many individuals through various parts of the southern counties, and even as far north as Derbyshire, practise the same with success. But the experiment is well known to have been made for many years on a large scale, and with complete results; at Pain's Hill, by the Honourable Charles Hamil-

ton, in a situation, with respect to soil and exposure, of which parallel instances are to be found almost every where throughout the country, and produced from land of no value whatever for the ordinary purposes of agriculture.

It is true, that the uncertainty of this climate will sometimes prevent the grapes from ripening : But this case is not without remedy.

Of the numerous varieties of grapes, it is well known to gardeners, that some are much more forward than others, and ripen their fruit at least a month earlier. It is obviously necessary to select for our purposes those which are the most early, if it is our desire to produce in every season a ripe crop. Of these, the Auvernat, the Miller, the White Muscadine, the White and Black Chasselas, the Black Sweet-water, and the Black Ham-burgh, are among those which ripen earliest, and with the greatest certainty. But I need not enter on this part of the subject, since it is fully known to gardeners.

It is more important to consider, what improvements may yet be made in the naturalization of this foreign plant, and whether care and attention may not, in time, produce new varieties, still more hardy and capable of ripening, with the same certainty as the currant or gooseberry. In a paper read before the Caledonian Horticultural Society, I slightly alluded to this subject, and pointed out

the methods to be followed in naturalizing exotic plants in general *. The observations of all gardeners have long since shown, that a tender exotic, rarely, if ever, becomes habituated to a climate, if it be propagated by layers, grafts, or cuttings ; since the new plant is always perfectly identical in all its habits and properties with the parent, of which indeed it forms a part. But a material change in the constitution of plants is produced by sowing the seeds, and the seedlings are invariably more hardy than the plant from which they were derived. I quoted in that paper some observations made by Sir Joseph Banks, on the naturalization of *Zizania aquatica*, and related an instance still more remarkable of a similar effect produced on *Canna indica*, a native of the West India islands, by successive sowing of the seeds in Guernsey. From these two remarkable facts, and perfect examples of success, as well as from innumerable more imperfect trials, it seems clearly established, that any plant may be naturalized to this climate, provided its seeds can be made to grow in succession. This, however theoretically true, is obviously attended with much practical trouble, in consequence of the difficulty of descending equally, and for a given length of time, through a given range of temperature ; a difficulty which would, in fact, in most cases, be insuperable. But no such obstacle prevents the further naturali-

* Published in vol. i. p. 284. of the Memoirs of the Society.

zation of those which produce seeds already in our summer temperature, and which are not destroyed by our winter frosts. Among these, the vine may be enumerated. To a certain extent it may indeed be considered as already naturalized, since it flowers every summer, and the winter frosts do not destroy it. So may the common laurel be looked upon as naturalized ; yet a severe winter will kill this shrub, as a cold summer will prevent the vine from bringing its fruit to maturity. It is by a sedulous culture of seedling vines alone, that we can hope to overcome this obstacle, and to produce varieties which shall ripen in all summers. For this purpose it is not sufficient to make trial of one or two successions of seedlings. Experience has shown, that numerous generations in a direct descent from the parent are required for the production of this effect. What that number is, has scarcely yet been ascertained, except in the cases of the *Zizania*, and the *Canna* above quoted ; but it probably varies according to the previous tenderness of the parent. In the vine, already considerably hardy, the object would probably be attained in a few generations. As I consider this object as one of prime importance, I venture to point it out to the serious attention of horticulturists, and as one which is likely to reward their labours. The production of new varieties will naturally follow these attempts, and by combining with them, the process of impregnating the flowers

with the *pollen* of different grapes, new and valuable ones may ultimately be produced. By the choice, therefore, originally, of proper varieties of the vine, and by such naturalization on these principles as we may be capable of producing, we shall have gained one great step in the art of making wine, from grapes of British growth.

The next step is the choice of that soil, exposure, and method of treatment, which is adapted, not only to the habits of the vine, but to that particular climate in which the cultivation is attempted. Our guide here must be the practice of those countries, whose climate most resembles our own; of certain parts of Germany and Hungary. An elevated situation, a southern exposure, shelter to the north and north-west, rocky and southern precipices, are peculiarly adapted to the situation of a vineyard; so are gravelly and rocky soils; a circumstance in another view advantageous, since these soils are of very little value for common agricultural purposes. But I forbear to enter into details, which are to be found in many essays on gardening, and in others which have been written expressly on this subject.

It is the more direct object of this essay to show that the making of good wine from grapes of British growth, does by no means depend on their maturation, and that this is not a necessary circumstance. The process of making wine from grapes will be reduced to a much narrower question, if

we can succeed in making it at all times, unchecked by seasons or accidents. A vineyard may thus be conducted with almost as little care as a gooseberry garden, with the certainty of a constant produce applicable to the purposes in view; and it will be in every one's power, in almost any situation. However precarious the ripening of the grape may be, its produce is not so. We are sure of an annual crop of grapes, but not of an annual crop of ripe ones.

It has been fully proved, by the facts and principles laid down in the first part of this essay, that a compound and artificial *must* can be fabricated from due mixtures of sugar, with the extractive matter and saline substances of fruits, capable of undergoing a regular fermentation, and of forming good and perfect wine. The case is as applicable to the grape as to the gooseberry. Long ago, experiments were made in France, by several chemists, with green grapes and sugar, and with complete success. I have repeated these experiments, and varied them with the best effects. The produce has varied with the management, and the results of the trials have been wines resembling Champagne, Grave, Rhenish, and Moselle, and of qualities so perfect, that the best judges and wine-tasters have not been able to distinguish them from foreign wines. The grapes may be used in any state, however immature. When even but half grown, and perfectly hard, they succeed

completely. It is evident that wines made on this principle, will be more expensive than when made from ripe grapes, as a sufficient quantity of sugar must be used, to compensate for the deficiency of the natural sugar of the grape. But even then, they are no more costly than currant or gooseberry wines, while, at the same time, their superiority is beyond all comparison. The hardest grapes will produce a wine of the strength of white Hermitage, with a proportion of three pounds of sugar to the gallon; and the expence will be trifling compared to the value of the produce.

It might be supposed that these wines would necessarily be devoid of flavour. But this is by no means the case, since all the specimens which were made under my direction, were characterized by flavours, as genuine and decided, as those of the foreign wines to which they approximated. I have little doubt, that under due management, on a large scale, and with sufficient age, wines of the Hock quality, could equally well be produced here in the same way.

Many trials must yet be made before we can hope to appretiate the extent of our resources in this manufacture. It is more than probable, that different grapes, even in this immature state, would produce different wines; but these trials must be left to the efforts of individuals, and to the necessarily slow progress of experiment.

With regard to the management, it must be founded on the operations followed in the wine countries, and of which a sufficiently full account for all the purposes of practice has already been given. It is in the first place obvious, that the grapes should be suffered (from motives of economy) to remain on the vines, while there is any hope of gaining an accession either of strength or sweetness. They should then be carefully separated from the stems; those which are mouldy or rotten, being at the same time rejected. Some judgment will be required in proportioning the fruit to the water in the first instance, and to the sugar in the second. I have before said, that the grape, when ripe, consists of sugar, combined with vegetable extractive matter, or the fermenting principle, and certain salts, besides the astringent and flavouring matter. As the colour is not developed in the immature grape, it need not be noticed here. But the proportions of these ingredients vary materially, according to the state of maturity of the fruit. As a great part of the saline and other constituents of the grape, appear to be converted into sugar, during the process of maturation; it is plain, that, weight for weight, there will be more of the principles contained in the immature, than in the mature fruit. To form, therefore, a *must* of such a quality as shall resemble the natural *must* of ripe fruit, it is necessary that water should be added to the immature juice,

for the purpose of diluting, and thus diminishing the proportions of those saline matters, which would otherwise confer on the wine a degree of harshness, difficult to overcome.

As it is impossible to give positive rules to meet the infinitely varying and undefinable degree of maturity, in which the grape must often be used, and as such rules would in fact but tend to mislead, I shall content myself with laying down some general principles, as I have done on former occasions, leaving the application to the ingenuity and observation of the operator.

If the object be to produce a wine which shall resemble Champagne, or the white wines of Bourdeaux, a small proportion of crude grape, will be required. Grapes barely half grown, require, for the production of wines of this class, to be used in the proportion of equality to water. If they are more grown, the proportion may be increased; if less, it may be diminished. If the intention be to make a wine resembling Hock, the proportion of grapes must be materially increased, and the wine at first harsh, austere, and not drinkable when new, will, by a few years residence in the cask, undergo that amelioration which time alone can give. To the proportions which I have described, varying quantities of sugar may be applied. A proportion of two pounds in the gallon of mixture, will yield a very light wine, of no great durability, resembling (under the proper treatment), the

inferior classes of Champagne wines, and under a different mode, a wine resembling Barsac, and the lighter of the Bourdeaux wines. An increase of the sugar to three pounds, will yield a wine equal in strength to the best sorts of Champagne, or if fermented to dryness, to the strongest of the white wines of Bourdeaux. Larger doses of sugar, will doubtless yield wines of different qualities, but of such proportions I cannot speak from experience. I may only caution the operator who shall undertake these trials, that larger quantities of sugar require larger proportions of fruit, if it be his intention to work the wine to dryness, as the quantity of fruit above-mentioned, is but barely sufficient to convert the proportion of three pounds above named. With regard to the durability of these wines, I may add, that I have kept them for seven years, and during all that time with evident improvement. I should consider them to be as little liable to destruction, as foreign wines of the very best *fabrique*.

While, on the subject of sugar, I may also say, that the general cause of failure in those wines which are made in this country from ripe grapes, is the deficiency of sugar, and that even these would be much improved by an addition of it. It is owing to this deficiency that these wines are perishable, and easily converted into vinegar, the natural *must* being too aqueous to produce a durable wine. The proportion of sugar need not

be larger in these cases; but, as before remarked, no positive rules can be given for it, since it must vary with the maturity and saccharine quality of the fruit,—circumstances which differ in almost every season.

Two modes of management may be adopted with regard to the fruit, either subjecting the skins to the fermentation, or not. In the first case, a greater degree of austerity will be the consequence; and the wine will consequently vary in its qualities. If the object be to make a wine resembling Champagne, the skins may be separated previously to the fermentation. If this manufacture be conducted on a large scale, the result of the second pressing may be reserved to make a distinct wine. If, on a small one, it may either be mixed with the first, or rejected altogether.

The methods of conducting the fermentation, as well as all the after management, need not be repeated here, as they are to be found in the beginning of this essay. From these, the operator will be directed to the several sorts of wine he may wish to make. It is equally unnecessary to repeat, that wines produced in this way, may be modified either in flavour or colour, by the several expedients already detailed. But let me again inculcate, that the wine is not made when the ingredients have been introduced into the vessel. It is then that the labour begins, and nothing but

Care and attention to every part and every minute circumstance of the subsequent processes, can ensure satisfaction, and produce valuable results.

To such uses may the immature fruit of the vine be converted ; but the capacities of that plant are not even yet exhausted. Situations may be found in this country where the vine may not produce even immature fruit ; yet still it can be directed to the end of wine-making. Chemical examination has proved, that the *young shoots* the *tendrils*, and the *leaves* of the vine, possess properties, and contain substances exactly similar to the crude fruit. It was no unnatural conclusion, that they might equally be used for the purposes of making wine. Experiments were accordingly instituted in France with this view, and they have been repeated here with success. From vine-leaves, water, and sugar, wines have thus been produced in no respect differing from the produce of the immature fruit, and consequently resembling wines of foreign growth. The few experiments which I have tried have been eminently successful. No further rules can be given respecting the management of the leaves, in addition to those I have laid down for the treatment of the unripe fruit. Similar proportions and similar management will, in both cases, produce similar effects. The leaves, however, scarcely yielding any thing to the press, require to be in-

fused in the water for some days before they are subjected to fermentation, and they seem to yield their soluble parts most readily to boiling water, without any material alteration in the result. The leaves of the Claret vine thus treated, produce wine of a delicate red colour. Tartar appears also to be a useful addition in this case; and it may be added in the proportion of half a pound, or even one pound, to ten gallons of the *must*. One advantage results from the use of the leaves. This is the facility with which they are reproduced during the growth of the vine; and thus, the produce of a small vineyard in leaves alone will be abundant; and that even of a single vine will be as great as is required for the use of most families, should they make this wine for their sole consumption. Let it always be remembered, that in all these cases, the price of the sugar is the price of the wine. The expence of utensils and labour is comparatively trifling, and, when the manufacture is upon a small scale, scarcely worthy of regard.

I have thus brought to a conclusion the remarks which I purposed to make on the art of fabricating wines in Britain. That I have offered so little from my own experience, will be pardoned

by those who consider that each experiment must extend to a period of one or two years, and that the labour of a life would be insufficient to reduce every one of these suggestions to practice. It will be enough, that they are all readily deducible from the labours of others, or from fair analogies taken from established rules of practice in the wine countries. The co-operation of many, to which I may hope that this essay will afford additional facilities, will in time improve this practice to that degree of perfection of which it is capable, and establish it on a sure and solid basis.

WOOLWICH, }
May 1815. }

NOTE.

THE Council of the Caledonian Horticultural Society strongly recommend the foregoing essay to the attention of all who wish to promote improvement in the manufacture of domestic wines. They suspect, that to many, who are in the habit of making such wines, the general *principles* on which the process depends are nearly unknown, and that others, though in some measure acquainted with these principles, still trust too much to chance.

As the Society will continue to give every encouragement in their power to the improvement of the manufacture of domestic wines, they have earnestly to request every one who may be engaged in it, to keep a memorandum of the whole process which was followed, even the

most minute manipulations. It is intended, when a very superior wine is produced in competition, to bestow a distinguished honorary reward, provided it shall appear that the maker has fully understood, and carefully acted upon, the scientific principles, the only certain guides to success.

The Council may remark, that some individuals in this place have already made considerable progress in naturalizing the vine from the seeds of plants kept in the open air; and, as there is no difficulty in sowing seeds, (which will vegetate though the grape be unripe,) and in watching when the plants thus produced yield a few grapes in the open air, the seeds of which are again to be sown, proceeding in this way to several generations; hopes may be entertained of some varieties of the grape being obtained, which will never fail to give abundant crops of tolerably ripe fruit; and *that* in no long time, since, under proper management, the vine may be expected to shew fruit in three or four years. In the mean time, the *leaves* (as suggested by Dr Macculloch) may be tried; but it ought to be observed, that some shoots, from which fruit may be expected, should not be stript of a single leaf. Indeed, for the purpose of making wine from the leaves, it would be better to plant vines of any sort, and to preserve the seedlings with the greatest care. To give a pleasant colour to wines, the Claret grape may be cultivated for its leaves.—Premiums will be given for Scottish grape wine, and a Gold Medal for the first good Scottish grape raised from seeds produced in the open air in Scotland.

